2018

Big Plains Water and Sewer Special Service District Wastewater Study

A study produced by Ensign Engineering in cooperation with the Big Plains Water and Sewer Special Service District and the Department of Environmental Quality

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1.0 EXECUTIVE SUMMARY

Big Plains Water and Sewer Special Service District (BPWSSSD) is the public entity overseeing wastewater and water connections in Apple Valley. Traditionally wastewater in Apple Valley has been managed through septic tanks and leach fields, however, there is concern that too many septic tanks in a confined location will lead to public health and water quality problems. Given the relative shallow groundwater wells, which is the source of all of Apple Valley's public drinking supply, and relative thin aquifer this concern is especially valid in Apple Valley. To evaluate the potential risks to the groundwater and surface water in the BPWSSSD boundaries, a mass balance approach was used to look at nitrate concentrations. This same approach has been used in many studies in the past, including a study performed by Hansen, Allen, and Luce for Washington County Water Conservancy District (WCWCD). There is no hard-regulatory number for allowable concentrations of nitrates in the groundwater, however, several technical reports and studies indicate concentrations below 3 mg/l to 5 mg/l is acceptable (some studies even allow up to 8 mg/l). For this study 5 mg/l was used as the threshold for analysis.

Through the mass balance analysis it is anticipated that groundwater nitrate concentrations are near 2.5 mg/l near Apple Valley at the current time. This concentration does not pose an immediate health risk, and Consumer Confidence reports of the nearby groundwater wells do not show elevated levels of nitrates. If septic systems are allowed to continue to be the wastewater treatment mechanism for new development in BPWSSSD, the nitrate concentration is estimated to reach 5 mg/l by the year 2042. The total population plus population equivalence for this threshold is approximately 1,979. However, if new developments are required to treat wastewater to a higher standard this delays the need for traditional sewer collection and treatment. If new commercial developments are required to remove nitrogen by 90% and residential lots remove by 70%, then nitrate concentrations are not estimated to reach 5 mg/l until 2060.

BPWSSSD has several options of how to control wastewater in the future. Regional treatment by Ash Creek Special Service District (ACSSD) is likely the most expensive; however, it will not require BPWSSSD to hire maintenance and operations personnel to maintain wastewater systems. This option would require Apple Valley to be annexed into Ash Creek SSD boundaries.

Facultative lagoons are likely less expensive than connecting with Ash Creek. However, because of the topography in Apple Valley, there would need to be 2 lagoons and 2 separate sewer collection systems, much like the water system currently operates. BPWSSSD must also maintain the collection and treatment system for the lagoons as BPWSSSD does not fall within the Ash Creek District boundaries.

Current residents that have septic systems, as well as continued residential systems, can remain on septic. New commercial development would be required to install alternative wastewater collection and treatment processes. These alternatives (Orenco and others manufacture such systems) would be required to reduce pollutants (nitrates, etc.) by a certain percentage. It is common for these systems to reduce total nitrogen concentrations by 70%, and with refinement, nitrogen can often be reduced by

90%-95%. This option would allow existing home and business owners to not incur additional costs for wastewater treatment, while new developments would be required to pay for these systems.

The preferred alternative would be to require all new major subdivisions to install a traditional sewer collection system. This system should be designed per state regulations and should be able to connect to a trunk line in a public ROW in the future. This would allow for a future trunk line to collect wastewater and transport to lagoons, or Ash Creek Special Service District. Additionally, BPWSSD may want to require treatment in the form of media filters on all developments, or a less aggressive approach would allow septic systems to continue.

2.0 INTRODUCTION

2.1 Background

Big Plains Water and Sewer Special Service District services parts of eastern Washington County which includes the town of Apple Valley. State Highway 59 is the main access through town. The valley that BPWSSSD serves is generally surrounded by Gooseberry Mesa to the north, Little Creek Mountain to the south and west, and Smithsonian Butte and Canaan Mountain to the west. This arid area receives little precipitation each year and is dependent on underground wells to provide culinary and irrigation water. The public water supplier in the area is BPWSSSD which owns seven wells, although all are not active. The two main development areas in the Town of Apple Valley are both located along Highway 59. The first is near the Little Plain area, west of Smithsonian Butte and South of Gooseberry Mesa. The other area known as Cedar Point, is located east of Big Plain Junction, and west of Canaan Mountain, primarily in sections 14, 15, and 23 of Township 43 South, Range 11 West, Salt Lake Meridian. The topography in the area shows a high point along Highway 59 between Apple Valley Ranch Subdivision and Cedar Point splitting the valley into two-sub basins. There are also many private wells throughout the valley that provide both culinary water for homes and irrigation for some center pivot sprinklers. There are few businesses in the area, with the primary one being a gas station near the Apple Valley Ranch subdivision. However, there has been substantial interest in future development including subdivisions and RV parks.

Currently residents and business owners in BPWSSSD boundaries use septic systems to manage waste. Due to the nature of their design, septic systems discharge treated wastewater into the ground. This water carries a load of potential pollutants, including nutrients, household chemicals, and pathogens. The level of pollution is mitigated by the mixing with groundwater and the infiltration from precipitation.

2.2 Purpose of study

The purpose of this study is to determine if wastewater from homes and businesses in Apple Valley has the potential to contaminate public drinking water sources. The aquifer that lies beneath Apple Valley is relatively thin, varying from about 40’ thick to as much as 150’ in the western edge of the valley, but most of the aquifer is about 50’-80’ thick. The aquifer depth varies from 90’-190’ feet. Having a relatively thin and shallow aquifer makes Apple Valley particularly vulnerable to wastewater contamination. This study will examine if and when source contamination is likely if Apple Valley continues to grow and uses septic systems as a means of wastewater treatment.

2.3 Previous studies

- ***Determination of Recommended Septic System Densities for Groundwater Quality Protection*** – 1997 (Hansen, Allen, & Luce) –This study was commissioned by Washington County Water Conservation District (WCWCD), along with State agencies, local and county governments, and the Environmental Protection Agency to "recommend appropriate septic system densities that may be used to help ensure long term protection of regional groundwater quality…" Many view this study as the definitive work on septic system densities in southern Utah. One key element of the analysis is the identification of nitrate concentrations as a key pollutant indicator to be used in determining septic system densities. At the time of the study, there was little information on Apple Valley. However, it was recommended that densities not exceed 5 acres per septic system.
- ***TMDL Water Quality Study of the Virgin River Watershed*** – 2004 (TetraTech, for UDEQ).
- ***Virgin River Watershed Management Plan*** – 2006 (Jointly funded by WCWCD, UDEQ, BLM, City of Saint George, Town of Springdale, and others)

3.0 TOWN DATA

3.1 Number of Septic Systems by Area

For the purpose of this study, the District was divided into several areas. The areas were determined because they represent a grouping of properties that: may share a common access to Highway 59; are in a common subdivision; are separated from other areas by drainage features; are a single large-system septic, etc. Based on this review, there are 344 residences, and 149 platted lots that currently do not have a water connection. Exhibit 2 shows area boundaries.

Cedar Point and Canaan Mountain Area – This area includes the Cedar Point subdivision, South Zion Estates subdivision, Canaan Mountain Estates subdivision, and several other residential lots in the area near Highway 59 on the south-east area of the town. This totals 116 lots, 64 with current water connection. There are no commercial water connections in this area. The average summer water usage for this area is 416 gallons per day (gpd).

Gooseberry Mesa – This area is the Apple Valley Ranch Gooseberry Mesa subdivision. There are 99 lots, 59 of which have a current water connection. The average water usage is 270 gpd.

Greater Apple Valley Area – This area includes the gas station and convenience store just off of highway 59, and all residential lots within all phases of the Apple Valley Ranch subdivision. This includes the lots on the south side of Highway 59 and north side of Highway 59. There are 198 lots within this area. Of those 198 lots 141 have current water connections. The average water usage in the summer for this area is 270 gpd.

Paradise Canyon Area – This area includes home near Paradise Canyon on the east side of Little Creek Mesa. There are 34 residence with water connections in this area. The homes use an average of 347 gpd during summer months.

Outlier Homes – There are several homes scattered through Apple Valley that don't fall into any of the aforementioned areas. These are typically on large lots, and live in more remote areas within Apple Valley Town boundaries.

3.2 Non-Residential Systems

The Town has few commercial properties. The most notable commercial connection is the Little Creek Chevron Gas Station. The gas station is located near the Apple Valley Ranch subdivision on Highway 59.

3.4 Population Projections

The Governor's Office of Management and Budget projects that Apple Valley, along with Washington County, will grow at a fairly aggressive rate at approximately 3.61% annual growth from 2010-2030. This is not surprising as Washington County has seen significant growth in past years. In fact, previous to the 2008 recession, St. George was one of the fastest growing areas in the country. With Apple Valley being in a warm climate, (although it is about 5-10 degrees cooler than St. George) and having close proximity to popular National Parks, it is expected to grow at a fairly rapid pace.

Table 0-1 Population Estimates

	Census			Projections		
Geography	2010	2020	2030	2040	2050	2060
Washington County	138,115	196,762	280,558	371,743	472,567	581,731
Apple Valley town	701	999	1,424	1,887	2,399	2,953
Balance of Washington County	6,988	9,955	14,195	18,809	23,910	29,433

3.5 Determination of Flow Rates

To determine appropriate daily flow rates per person, several recent studies were compared.

Per HAL study (1997), "**Septic System Effluent Flow.** Typical values for the amount of flow discharged by the average residence vary from approximately 200 to 400 gallons per system per day. The increasing awareness of water conservation will likely result in long term values that are nearer the lower end of this range or even lower." And "**Septic System Effluent Strength.** Septic system effluent nitrate concentrations typically range from 30 to 80 mg/l NO_3-N. The increasing reality of water conservation practices will force this value to the upper end of the range. A value of 40 mg/l was used in this study."

Based on these studies, it was determined that a flow of 100 gallons per person per day (gcd), and 326 gallons/household/day would be used for this study.

3.6 Precipitation

Little and Big plains increase in elevation from approximately 4675 feet to 4900 feet traveling from the north west heading south east through the valley. This puts the average elevation in Apple Valley around 4800 feet. The closest weather stations to Apple Valley are the La Verkin station 10.5 miles northwest and the Colorado City Station 11 miles to the southeast. The Zion National Park weather station, which is approximately 11 miles to the northeast, is arguably the wettest area in this part of the state. The average precipitation here is only 16.1 inches. Even though there are no weather stations on top of the high land areas surrounding Apple Valley, it is reasonable to assume that these areas receive less than 16 inches of rain a year. Interpolation shows that the approximate amount of annual precipitation in Apple Valley to be near 13 inches.

Table 0-2 Average Annual Precipitation (in)

Zion NP	16.1
La Verkin	11.6
Colorado City	13.5
Apple Valley (Interpolated)	13.0

3.7 Current Septic Loading – Population Equivalence

Population equivalence is a way to show the equivalent loads from all sources, both residential and commercial as a ratio to the amount of load from household waste produced by one person in that same amount of time. The population equivalences for the 5 study areas include where calculated according to water usage data supplied by the town. Lots that currently do not have a water service connection are assumed to use the average amount of water as the rest of the lots, and are included in the analysis. The current population equivalence including platted lots that do not have a water connection is calculated and shown in table 3 and totals to be 1,837. Analysis is based on the general volume usage of 100 gpd per capita.

Table 0-3 Population Equivalence 2016

Cedar Point Population Equivalence	Quantity	Flow (GPD)	Total	
Residential				
Current Water Connections	50 connections	416	20,800	
Platted lots (as residential units)	52 Lots	416	21,632	
Canaan Mountain Lots	14 Lots	416	5,824	
	Total Flow		48,256	
	Flow per PE		100	gal/day/per
	Population Equivalence		483	

Gooseberry Population Equivalence	Quantity	Flow (GPD)	Total	
Residential				
Current Water Connections	59 connections	270	15,930	
Platted lots (as residential units)	40 Lots	270	10,800	
	Total Flow		26,730	
	Flow per PE		100	gal/day/per
	Population Equivalence		267	

Apple Valley Population Equivalence	Quantity	Flow (GPD)	Total	
Residential				
Current Water Connections	141 connections	419	59,079	
Platted lots (as residential units)	57 Lots	419	23,883	
Commercial				
Service station - 2gpd/vehicle, assume 100 vehicles	1 Service Station	200	200	
	Total Flow		83,162	
	Flow per PE		100	gal/day/per
	Population Equivalence		832	

Paradise Canyon Population Equivalence	Quantity	Flow (GPD)	Total	
Residential				
Current Water Connections	34 connections	347	11,798	
	Total Flow		11,798	
	Flow per PE		100	gal/day/per
	Population Equivalence		118	

Outlier Homes Population Equivalence	Quantity	Flow (GPD)	Total	
Residential				
Current Water Connections	46 connections	300	13,800	
	Total Flow		13,800	
	Flow per PE		100	gal/day/per
	Population Equivalence		138	

4.0 RISK ANALYSIS

4.1 Analysis Approach

To analyze the potential degradation of the groundwater and surface water in BPWSSSD, nitrogen concentrations were chosen as the key indicator for groundwater quality. Analysis from past studies including Hansen Allen and Luce, and the State of Massachusetts all indicate that nitrogen is one of the best indicators for water quality in both wells and surface water bodies (DeFeo, Wait & Associates, 1991). Nitrates in drinking water pose risks to health including methemoglobinemia, or "blue baby syndrome" which can cause severe illness or death to infants less than 6 months of age. Because of these health risks the United States Environmental Protection Agency (EPA) has set the maximum contaminant level (MCL) for nitrates in drinking water to 10 mg/l (EPA website, 2014).

The largest nitrate concentration occurs in human and animal waste and fertilizer, with some nitrates occurring naturally in the soil. In a traditional septic system nitrogen seeps into the underlying groundwater, where it remains largely as nitrates. There is little to no denitrification that can occur in the groundwater, because denitrification must occur in an anaerobic environment. This is another good reason why nitrates are suitable as a key indicator for water quality.

4.1.1 Nitrate Concentrations in Groundwater

A mass balance approach was taken to determine the level of nitrates in the groundwater. The primary equation is as follows:

$$Q_t N_t = Q_b N_b + Q_p N_p + Q_i N_i + Q_s N_s$$

This equation can be manipulated to solve for the final concentration in the groundwater (Nt) given a total number of population equivalence, or can be solved for the number of population equivalence given a certain nitrate concentration.

Completed computations can be seen in Appendix C, and the following assumptions were made.

4.1.2 Background Flow of Groundwater

The background flow of the groundwater (Qb) and associated nitrate loading (Nb) is the ambient flow associated with the aquifer. The hydraulic conductivity of the aquifer (k) was assumed to be 3 feet/day, the mixing zone thickness (d) was assumed to be 60 feet, the aquifer width (b) was assumed to be 10,000 feet, and the hydraulic gradient (i) was assumed to be 0.05. The background nitrate concentration was assumed to be 0.5 mg/l. These assumptions are based on other studies in the area, as well as well logs and recent water quality samples.

4.1.3 Recharge Associated with Precipitation

The recharge associated with precipitation (Qp) and the associated nitrate loading (Np) refers to the amount of precipitation that is able to percolate into the aquifer. The precipitation (p) was interpolated between the two nearest weather stations to be 13 inches/year. The amount of this water that is able to infiltrate into the aquifer is estimated to be 15%. The drainage area for the aquifer (Ad) is estimated to be 6,000 acres. The nitrate loading was assumed to be 1 mg/l.

4.1.4 Recharge Associated with Irrigation

Similar to the recharge associated with precipitation, the recharge associated with irrigation (Qi) and associated Nitrate Loading (Ni) is the amount of water able to percolate into the aquifer during irrigation. It was assumed that 25% of a lot size is being irrigated. 6 acre feet/acre is common in the arid southwest portion of Utah for irrigation purposes and was chosen as the irrigation rate (Ir). It is common practice to assume 50% of irrigation reaches the aquifer. The nitrate loading was assumed to be 1 mg/l.

4.1.5 Wastewater Flow from Septic Tanks

Wastewater flow from septic tanks (Qs) is the amount of effluent attributed septic systems. The nitrate loading (Ns) is estimated to be 40 mg/l as demonstrated in the Hansen Allen and Luce study for residential entities and 100 mg/l for commercial entities (Veneman, et al; Gross; Henze). It should be noted, however, that nitrate concentrations can vary greatly with respect to types of uses. Commercial entities are likely to have nitrate concentrations greater than 100 mg/l, with RV parks and food processing plants likely to have concentrations greater than 150 mg/l.

4.1.6 Total Flows and Concentrations

The total flow in the aquifer (Qt) is simply the sum of all of the other flows ($Q_b + Q_p + Q_i + Q_s$). The total nitrate concentration (Nt) is the key indicator for the quality of water in the aquifer.

4.1.8 Thresholds of Nitrate Concentration

Considering the mass balance computation, and given the assumptions which support the computation, it is possible to develop recommendations regarding the number of septic systems which can reasonably be constructed within pods or subdivisions in Apple Valley. The current limit for nitrates in drinking water, as set forth by the EPA, is 10 mg/l. This limit was set under authority of the Safe Drinking Water Act, and became effective in 1992. The limit is reviewed every 6 years, and although the limit was maintained at 10 mg/l during the last two review cycles, the possibility exists that the limit could be lowered. It was determined, that for the purpose of this study, 5 mg/l of nitrate concentration is the threshold in which water quality is deemed unacceptable for drinking water purposes.

A concentration of 5 mg/l seems like an appropriate level given the current state and use of groundwater in Apple Valley. Allowing the nitrate concentrations to rise above 5 mg/l would not be a wise water management strategy. If the groundwater is saturated past a level of 5 mg/l nitrates, other pathogens contained in wastewater might start to show their effects in culinary water wells. As stated previously, nitrogen is not the only concern for wastewater contaminants. Other pathogens and contaminants are contained in wastewater. Nitrate levels are a “key indicator” of the quality of wastewater, and even though the nitrate concentrations might be below the MCL, other contaminants might be causing problems in downgradient water sources.

4.1.9 Current Water Quality Tests

According to the Consumer Confidence Reports, there were no violations of the contaminants tested (turbity, alpha emitters, arsenic, barium, chromium, copper, lead, nitrate, selenium, sodium, sulfate and total dissolved solids). Additionally, historically in Apple Valley Well #1 showed 0.73 picoCuries per liter (pCi/L) and Well #2 showed 2.6 pCi/L of Radium-228. This is below the maximum contaminant level (MCL) of 5 pCi/L. Likewise the Consumer Confidence Report for Cedar Point show that there were no violations of the contaminants tested.

4.2 Mass Balance Results

The mass balance analysis was conducted to determine the maximum number of population equivalent units which can be accommodated in the separate areas discussed before. Certain assumptions were made regarding both the quantity of water and the nitrate concentrations in groundwater, precipitation, irrigation, and septic system discharge and have been explained previously. Thresholds of "acceptable concentration" greatly influence the PE's which the Town can allow when considering future development. The selection of what the Town considers as "acceptable concentration" must be carefully considered, as the higher the concentration is allowed to rise equates to a higher level of risk to the Town.

The "Current Condition" Population Equivalence computation includes a value for 149 platted lots, which are currently undeveloped, but need only a building permit to begin construction of homes. This overestimates the population equivalence of the current condition by about 100. As can be seen from table 5, the current nitrate concentration in the groundwater is estimated to be about 2.54 mg/l in Apple Valley. By the year 2042 the nitrate concentration is projected to reach 5 mg/l if development is allowed to continue to develop on septic systems. Because of the low densities in Paradise Canyon and the Outlier Homes, the nitrate concentrations in these areas are minute.

Table 0-1 Mass Balance Results

		Cedar Point			Apple Valley			Gooseberry		
Year	Projected Population	Nitrate Concentration	Residential PE	Commercial PE	Nitrate Concentration	Residential PE	Commercial PE	Nitrate Concentration	Residential PE	Commercial PE
2015	837	2.54	424	0	3.65	830	2	2.36	326	0
2020	999	2.92	506	1	4.20	991	2	2.70	389	1
2025	1193	3.35	604	1	4.82	1,183	3	3.09	464	1
2030	1424	3.85	721	2	5.55	1,412	3	3.55	554	2
2035	1639	4.30	830	2	6.19	1,625	4	4.07	661	2
2040	1886	4.80	955	2	6.90	1,870	5	4.68	789	2
2045	2127	5.28	1,077	2	7.57	2,109	5	5.39	942	3

4.3 Assessment of Risk

4.3.1 Risk to groundwater quality

The risk to groundwater contamination from wastewater is much greater than that for surface water contamination. Groundwater in Apple Valley is the main source for drinking water, so protection of ground water sources must be a priority. Consumer Confidence reports for the Apple Valley Water System and Cedar Pointe Water System were reviewed to determine existing water quality and the risk proposed to water quality as development occurs and additional septic tanks and on-site treatment plants are implemented within the system. There are currently not traces of nitrates in the existing groundwater areas tested. The existing production wells are located away from higher density areas but as growth occurs, these areas will fill in. This growth will increase potential for increased contamination and nitrate levels.

Care needs to be taken going forward as to not begin to contaminate the groundwater where it is the sole supply of drinking water in the valley. There is not a river that feeds Big Plains and it relies on groundwater recharge through rain and snowfall to sustain groundwater levels. That being said, it would not take much to contaminate the groundwater to make it unsuitable for drinking water purposes.

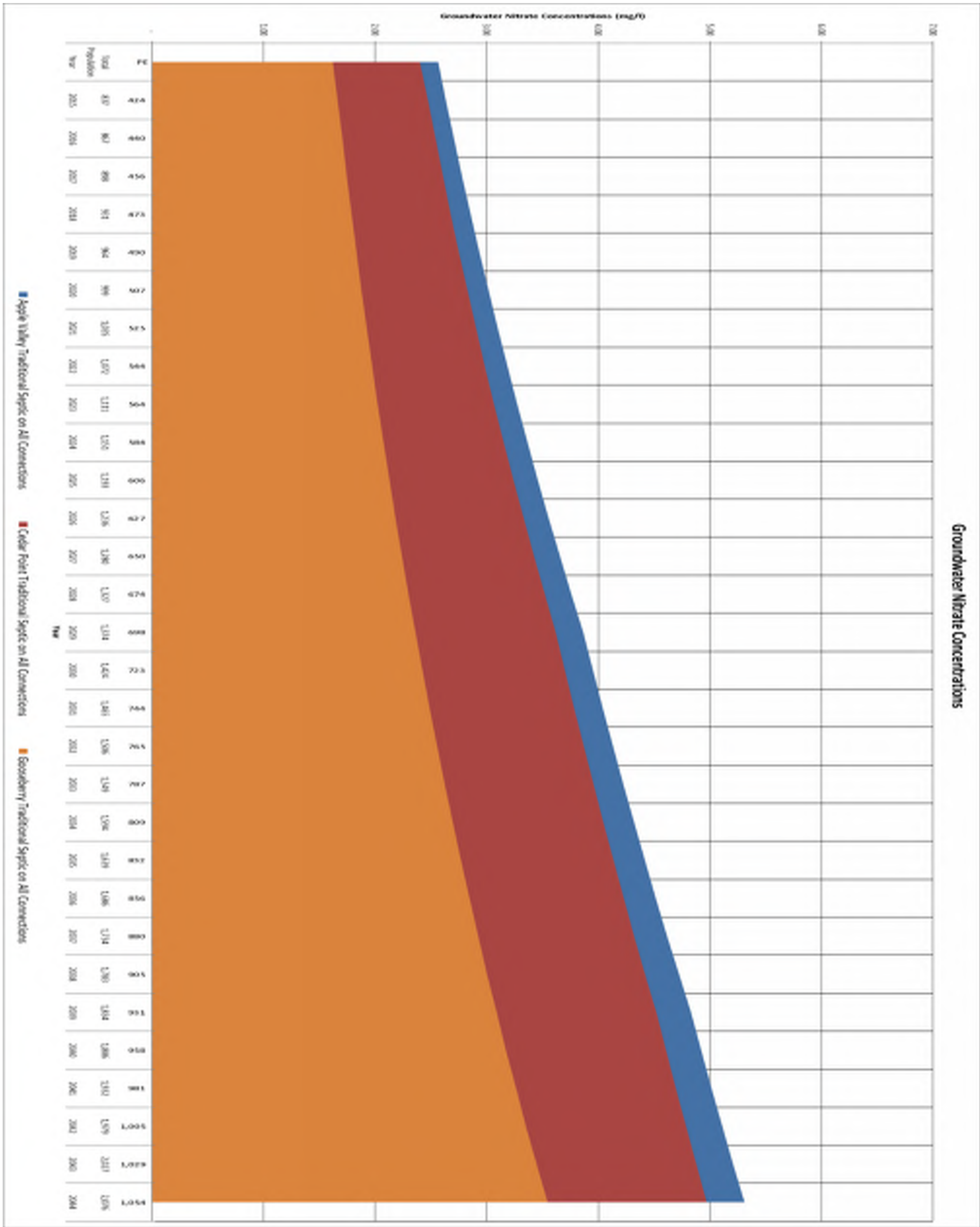

Figure 1 Estimated Nitrate Concentrations in Groundwater

5.0 ALTERNATIVES ANALYSIS

5.1 On-Site Septic

Traditionally Apple Valley, along with much of rural Utah, uses on-site septic tanks as a means of wastewater treatment and disposal. In small quantities, septic tanks do a fairly good job at limiting the side effects of pathogens and other harmful substances. However, once too many septic tanks are installed in a confined area, the potential risks for groundwater and surface water contamination increase. Because septic tanks rely on dilution to limit the concentration of harmful substances in the groundwater, and eventually the surface water, there will inevitably a point when the groundwater is over saturated with a contaminant. Septic tanks are fairly cheap and easy to install (estimated to be $10,000 with leach field), but do require pumping every 3 to 5 years (estimated to be $500 per pump).

5.2 STEP STEG Collection with Treatment

Septic Tank Effluent Pump (STEP) and Septic Tank Effluent Gravity (STEG) systems are becoming increasingly popular in rural and semi-rural communities for wastewater collection. These systems work by receiving waste in a septic or interceptor tank immediately outside of a home or commercial entity. Once in the tank the waste solids separate from the liquids. The liquids are then either pumped, or flow by gravity to a centralized collection point where treatment occurs. The solids remain in the tank and are able to anaerobically digest. Depending on the size and demand on the tanks, the tanks will need to be pumped every 8-15 years. The benefits of STEP STEG are:

- Cheaper to construct than traditional sewer collection system
- Because the effluent out of the tank is solids reduced, pumping costs are minimal
- Less cost for developers

Once the effluent reaches a centralized point treatment often occurs in the form of media filters that may include primary treatment, pre-anoxic treatment, and post-anoxic treatment. This "hybrid option" would allow those existing connections that are currently on a septic system to remain on the septic system, but would require new developments (commercial, residential, or both) to have some sort of alternative wastewater treatment option. These treatment systems are estimated to remove 70% -95% of total nitrogen concentrations, which would greatly improve the nitrate concentrations in the groundwater. This alternative places more responsibility on the developer to fund and construct an alternative wastewater collection and treatment system. An approach the District might want to take is to set either a wastewater nitrogen discharge limit, or nitrogen reduction percentage before new developments are approved.

5.3 Facultative Lagoons

The implementation of facultative lagoons is an option that is often realized by small to medium sized towns in Utah. Facultative lagoons can offer reuse for irrigation after secondary treatment, and in many parts of Utah, lagoons are utilized when land is fairly cheap, and the community has a strong agriculture presence. Approximately 25 acres of lands would need to be acquired to construct the lagoons, and either the Town must own land for reuse, or a long-term lease agreement must be signed with a land owner. Type II reuse is limited to applications were human exposure is unlikely, however, it is likely that it will be many years after the lagoons are constructed that they will have excess water for irrigation. Constructing lagoons would require BPWSSSD to have wastewater maintenance personnel to maintain the wastewater treatment and collection systems, or have an annexation agreement with Ash Creek Special Service District. The proper design and maintenance of the lagoons would have to comply with State Rules.

5.3.1 North Lagoons

One possible location for lagoon placement is west of Apple Valley, west of Little Mountain Mesa. This area is private land down gradient from Apple Valley. This site would allow gravity flow for the Apple Valley area, but effluent from the Cedar Point Area would require pumping. Other sites in the area exist including some sites north of Highway 59. The existing soils data indicate that soils are sandy loam, which may indicate additional import lining material may be required to construct the lagoons.

5.3.2 South Lagoons

Another possible location for lagoon placement is south of Cedar Point, near desert drive. This area is private land down gradient from the Cedar Point and Canaan Mountain Subdivisions. There are a couple private parcels, as well as public land managed by the Bureau of Land Management that may be suitable locations. This site would allow gravity flow for the Cedar Point and Cannan Mountain Subdivisions, but effluent from the Apple Valley Area would require pumping. The existing soils data indicate that soils are sandy loam, which may indicate additional import lining material may be required to construct the lagoons.

5.3.2 Combination North and South Lagoons

An alternative that would result in an all gravity sewer system would be to build 2 lagoon systems and operate 2 different systems. This would require a lagoon placed on the North end of Apple Valley, and one South near Cannan gap. The systems would be split along the high point on Highway 59. Each lagoon system would require approximately 15 acres each, which would accommodate growth for the next 30 years. The benefit of having two lagoons is that it would eliminate the need for a pressurized main between Cedar Point and Apple Valley. As this area becomes developed, developers would extend sewer main from either Cedar Point or Apple Valley to sewer new developments along Highway 59.

5.4 Regional Treatment by Ash Creek Special Service District

Ash Creek Special Service District services the towns of Hurricane and La Verkin as well as parts of unincorporated Washington County. Hurricane is approximately 19,000 feet from Apple Valley, and an interceptor sewer line would be needed to be constructed to connect Apple Valley to Ash Creek system. The most probable option is to connect in Hurricane. Connecting onto Ash Creek would mean Apple Valley would need to be annexed into Ash Creek SSD. A one-time impact fee of $2,976 per connection is required as well as a monthly service charge (Hall). This alternative would require most if not all homeowners in Apple Valley to abandon their septic tanks, and connect to the sewer collection system.

If regionalization occurred with Ash Creek, a pressurized sewer main from the Canaan Mountain, and Cedar Point area would be required to bring transport effluent from the southern areas to Apple Valley, where a gravity interceptor line could then relay the effluent to Hurricane. When Cedar Point Subdivision was developed, the developer was required to install sewer pipes throughout the subdivision. These sewer lines are currently dry and not used, but they are in place. According to the information gathered by town operators and as-built maps the installed sewer lines could be operational with some maintenance and cleaning.

The benefits of this system would include:

- Apple Valley not being limited in growth by wastewater treatment
- Ash Creek Special Service District maintain wastewater facilities-no maintenance from BPWSSSD.

5.5 Regionalization with Hildale and Utilize Hildale Lagoons

Hildale sewer ponds are a located about 6,700 feet southeast of Cedar Point and approximately 30 feet higher in elevation. The Hildale sewer ponds are designed to treat 1.023 Million Gallons per Day (MGD), and currently services residents of Hildale, UT and Colorado City, AZ and which is approximately 7,763 residents. Hildale currently maintains the sewer lagoons and all sewer infrastructure. If a sewer main to Hildale were to be built, it would likely have to be a pressurized main, as there is almost 120 feet in elevation difference along the alignment of the sewer main from Cedar Point to the Hildale Lagoons. Conversations with both Hildale City personnel and Department of Environmental Quality Engineers have led to the conclusion that Hildale approaches the capacity of these lagoons during peak usage months. It is not viable for the lagoons to handle more effluent form Apple Valley unless the lagoons are expanded.

5.5 Mechanical Treatment with Gravity Sewer Collection

Mechanical treatment plants and packages come in a variety of sizes, able to treat flows for a single connection to flows for an entire town. At a large scale, mechanical treatment can become expensive for small towns with limited budget and personnel. Tradition collection differs from STEP/STEG systems in that solids are conveyed in traditional collection systems while STEP/STEG systems have the solids settled in tanks before collection. Therefore, traditional collection requires greater mechanized treatment than STEP/STEG systems. These treatment plants will often include: phase separation, sedimentation, filtration, oxidation, biochemical oxidation, chemical oxidation, and polishing. It is unlikely that the District can afford a full-scale treatment plant, as well as provide operations and maintenance personnel.

6.0 ESTIMATES OF COST

Cost estimates for facultative lagoons, regional treatment by Ash Creek SSD, and a traditional collection system were evaluated and can be seen in the appendix. Both alternatives of either lagoons or treatment by Ash Creek will require a collection system. Connecting with Ash Creek, however, will have much lower operation and maintenance costs, as it will not require BPWSSSD to hire maintenance personnel. Alternative systems such as AdvanTex systems with a STEP STEG collection system vary in cost depending on the size and treatment level of the system, and are difficult to compare with the other treatment options because the other systems will be treating the entire town, while implementing alternative treatment systems over time will just be targeting new developments. Generally, for point of reference, however, the cost for a standard treatment system is $300,000 for a 50 lot subdivision. See appendix for detailed calculations.

Table 0-1 Cost Estimates

COLLECTION			
Apple Valley To North Lagoons	**Cedar Point to South Lagoons**	**Gooseberry Gravity Collection**	**Apple Valley Gravity Collection**
$ 635,175.00	$ 562,950.00	$ 1,068,122.51	$ 1,584,033.98
$ 635,175.00	$ 562,950.00	$ 1,068,122.51	$ 1,584,033.98
$ 6,351.75	$ 5,629.50	$ 10,681.23	$ 15,840.34
$ 180,150.31	$ 159,665.63	$ 302,944.23	$ 449,268.65
$ 815,325.31	$ 722,615.63	$ 1,371,066.74	$ 2,033,302.63

	TREATMENT		
Alternative	**Lagoons**	**Treatment By Ash Creek**	**Septic Tanks**
Construction Cost	$ 1,372,300.00	$ 5,525,685.00	$ 400,000.00
Net Present Worth	$ 1,372,300.00	$ 5,525,685.00	$ 400,000.00
Annual O & M	$ 11,000.00	$ -	$ 25,350.00
Net Present Worth (O&M)	$ 311,985.43	$ -	$ 718,984.60
TOTAL COST (NPW)	$ 1,684,285.43	$ 5,525,685.00	$ 1,118,984.60

TOTAL SYSTEM COST (NPW)	
Ash Creek	**Sewer Lagoons**
$ 8,930,054.37	$ 6,626,595.75

7.0 RECOMMENDATIONS

According to the analysis performed, the wastewater effluent from septic tanks in the BPWSSSD is currently not imposing any immediate health risks to the public. Given the low nitrate concentrations currently, and the high cost to implement a sewered system it is not necessary to immediately sewer BPWSSSD.

However, given the high risk if groundwater were to be influenced with wastewater it is recommended that BPWSSSD implement a wastewater strategy that would be flexible enough to adapt into a sewered system in the future. The preferred alternative would be to require all new major subdivisions to install a traditional sewer collection system. This system should be designed per state regulations and should be able to connect to a trunk line in a public ROW in the future. This would allow for a future trunk line to collect wastewater and transport to lagoons, or Ash Creek Special Service District. Additionally, BPWSSD may want to require treatment in the form of media filters on all developments, or a less aggressive approach would allow septic systems to continue.

APPENDIX A

References

Basic Information about Nitrate in Drinking Water. (2014, February 5). Retrieved May 7, 2015, from EPA website: http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm

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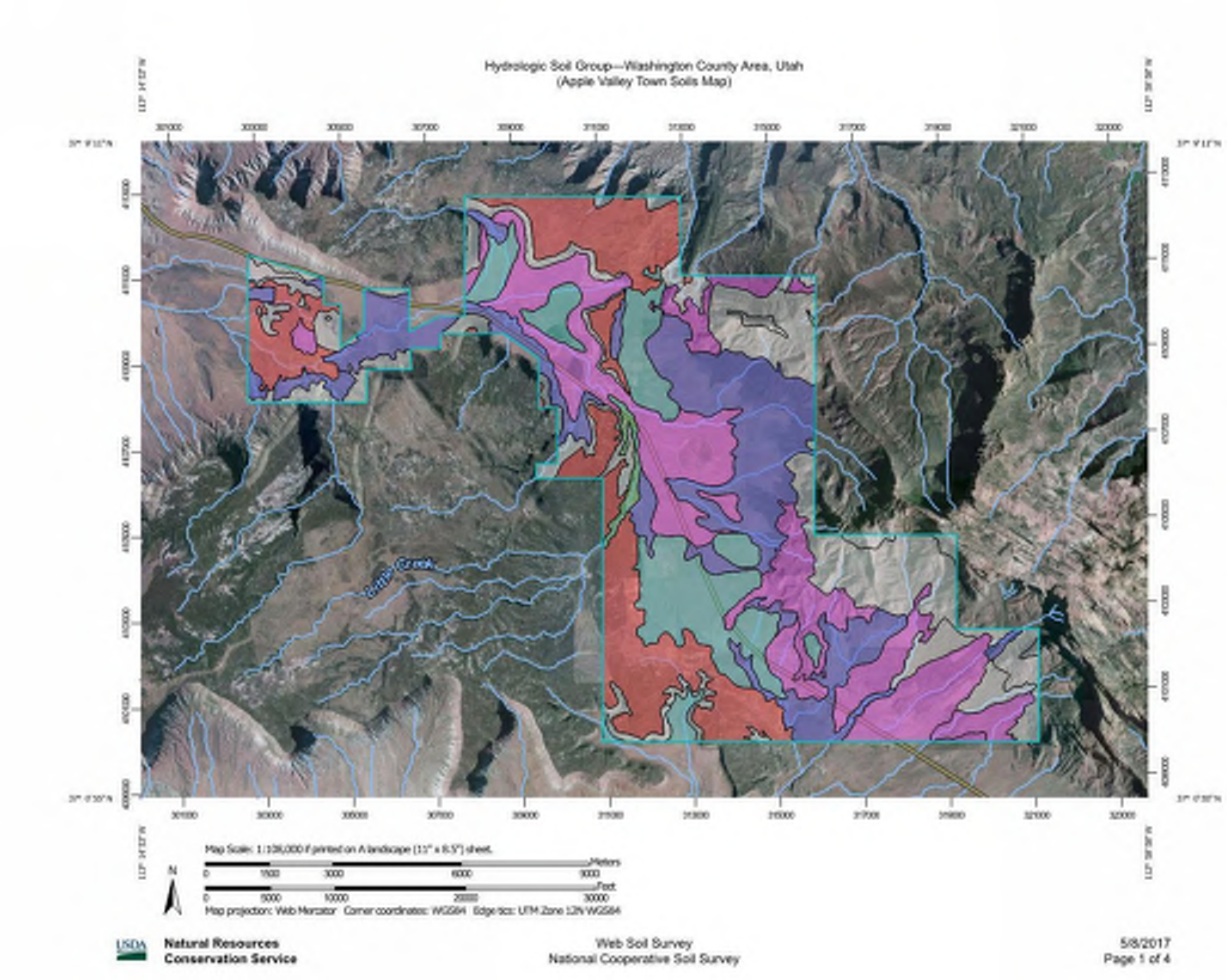
APPENDIX B

Soils Data



Hydrologic Soil Group—Washington County Area, Utah
(Apple Valley Town Soils Map)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County Area, Utah
Survey Area Data: Version 10, Sep 13, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 7, 2010—Nov 3, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Washington County Area, Utah (UT641)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BA	Badland		211.3	0.8%
BB	Badland, very steep		777.5	3.0%
BOD	Bond sandy loam, 1 to 10 percent slopes	D	4,135.5	16.1%
CI	Cinder land		137.8	0.5%
CoC	Clovis fine sandy loam, 1 to 5 percent slopes	C	3,050.9	11.9%
EA	Eroded land-Shalet complex		51.2	0.2%
FA	Fluvaquents and torrifluvents, sandy	A/D	191.9	0.7%
GA	Gullied land		550.4	2.1%
GP	Gravel pits		2.5	0.0%
MBG	Mathis-Rock outcrop complex, 20 to 50 percent slopes	A	1,369.0	5.3%
MFD	Mespun fine sand, 0 to 10 percent slopes	A	333.8	1.3%
NaC	Naplene silt loam, 2 to 6 percent slopes	C	180.5	0.7%
PAC	Palma loamy fine sand, 1 to 5 percent slopes	A	1,850.9	7.2%
PbC	Palma fine sandy loam, 1 to 5 percent slopes	A	2,728.0	10.6%
PED	Pastura-Esplin complex, 0 to 10 percent slopes	D	714.3	2.8%
RaC	Redbank fine sandy loam, 1 to 5 percent slopes	B	5,137.9	20.0%
RT	Rock outcrop		215.7	0.8%
SH	Schmutz loam	B	278.1	1.1%
SY	Stony colluvial land		3,809.6	14.8%
Totals for Area of Interest			**25,726.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C

Mass Balance Calculations

APPENDIX D

Cost Estimates

APPENDIX E

Water Quality Samples

ST. GEORGE REGIONAL WATER RECLAMATION LABORATORY ANALYSIS REPORT FORM

3780 South 1550 West, St. George, Utah 84790; (435)-627-4279; Fax (435)-634-5846

CUSTOMER INFORMATION: (fill out Bold areas)

☑ Drinking Water ☐ Swimming Pool/Spa

System Number: 27089

System Name: BIG PLAINS SSD

Address: 1777 N. MEADOW LARK DR.

APPLE VALLEY, UT 84737

Phone # 632-8358

Lab Numbers: W17-117-2

Report Drinking Water Sample as:

☐ Routine

☑ Investigative

Is Sample Chlorinated? ☑ Yes ☐ No

☐ Present Coliform Recheck

Original Sample #:

Original Sample Date:

Instructions to Samplers: Sample must be above the 100 ml mark, on ice and above freezing. Samples taken the previous day must be above freezing to 6°C

Analysis: ☑ Presence/Absence: TC & E. Coli - SM9223B ☐ HPC by SimPlate

☐ Quantitray: TC & E. Coli - SM9223B (test not certified by NELAP)

Preservation: ☑ Ice/refrig ☐ $Na_2S_2O_3$

Container: ☒ Plastic ☒ Grab Sample

Sampler: D. Harris Sample Date: 4/27/17 Witnessed by:

Released by: D. Harris Date: 4/27/17 Time: 1347 Received by: Date: Time:

Released by: Date: Time:

Received in lab by: JJ Date: 4/27/17 Time: 1:47P

Lab Use Only

Sample Condition

Holding Time____ Air Space in bottle____

Volume (100ml)____ Sample on Ice____

Temp of bottle (°C) 11.7

Test Results

	SM9223B	SimPlate
Test Method:	SM9223B	SimPlate
Test Date:	4/27/17	
Test Time:	3:41P	
Bench Sheet #:	63	
Tested By:	JJ	

#	Sample Location	Sample Time	Chlorine	Sample Lab Number	Total Coliforms Present	Total Coliforms Absent	E. Coli Present	E. Coli Absent	MPN/ml (MDL = 2)
1	MUSSER MAIN EXT.	1100	0.2	W17-117-2		✓		✓	
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments

Notified/Messaged client about sample: ☐ Result Violation ☐ Positive Chlorine, Sample rejected ☐ Not Received on Ice

☐ Outside >0-6°C, the day after sampling ☐ Other:

Reported to Required Authorities by: Date Sent:

The test results for the sample(s) entered on this report meet all the requirements for NELAP unless otherwise noted and relate to the sample(s) as received by the St. George Regional Water Reclamation Laboratory.

Approved by: Leslie Wentland Title: Lab Director Date Issued: 5/2/17

Page 1 of 1 Lab Form: DW 0112 revised by lf 1/10/12

ST. GEORGE REGIONAL WATER RECLAMATION LABORATORY ANALYSIS REPORT FORM

3780 South 1550 West, St. George, Utah 84790; (435)-627-4279; Fax (435)-634-5846

CUSTOMER INFORMATION: (fill out Bold areas)

Lab Numbers: W17-117-3

☑ Drinking Water ☐ Swimming Pool/Spa

System Number: 27089

System Name: BIG PLAINS SSD

Address: 1777 N. MEADOW LARK DR.

APPLE VALLEY, UT 84737

Phone # 632-8358

Report Drinking Water Sample as:

☐ Routine

☑ Investigative

Is Sample Chlorinated? ☑ Yes ☐ No

☐ Present Coliform Recheck

Original Sample #:

Original Sample Date:

Instructions to Samplers: Sample must be above the 100 ml mark, on ice and above freezing. Samples taken the previous day must be above freezing to 6°C

Analysis: ☑ Presence/Absence: TC & E. Coli - SM9223B ☐ HPC by SimPlate

☐ Quantitray: TC & E. Coli - SM9223B (test not certified by NELAP)

Preservation: ☐ Ice/refrig ☐ $Na_2S_2O_3$

Container: [X] Plastic [X] Grab Sample

Sampler: S. Harris Sample Date: 4/27/17 Witnessed by:

Released by: S. Harris Date: 4/27/17 Time: 1:47 Received by: Date: Time:

Released by: Date: Time:

Received in lab by: JP Date: 4/27/17 Time: 1:47P

Lab Use Only

Sample Condition

Holding Time ✓ Air Space in bottle ✓

Volume (100ml) ✓ Sample on Ice ✓

Temp of bottle (°C) 13.1

Test Results

	SM9223B	SimPlate
Test Method:	SM9223B	SimPlate
Test Date:	4/27/17	
Test Time:	3:41P	
Bench Sheet #:	63	
Tested By:	JP	

#	Sample Location	Sample Time	Chlorine	Sample Lab Number	Total Coliforms Present	Total Coliforms Absent	E. Coli Present	E. Coli Absent	MPN/ml (MDL = 2)
1	MASON - KAPLOS MAIN ENT.	1130	0.2	W17-117-3		✓		✓	
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments

Notified/Messaged client about sample: ☐ Result Violation ☐ Positive Chlorine, Sample rejected ☐ Not Received on Ice

☐ Outside >0-6°C, the day after sampling ☐ Other:

Reported to Required Authorities by: Date Sent:

The test results for the sample(s) entered on this report meet all the requirements for NELAP unless otherwise noted and relate to the sample(s) as received by the St. George Regional Water Reclamation Laboratory.

Approved by: [signature] Title: Lab Director Date Issued: 5/2/17

Leslie Wentland

Page 1 of 1 Lab Form DW 0112 revised by lf 1/10/12

ST. GEORGE REGIONAL WATER RECLAMATION LABORATORY ANALYSIS REPORT FORM

3780 South 1550 West, St. George, Utah 84790; (435)-627-4279; Fax (435)-634-5846

CUSTOMER INFORMATION: (fill out Bold areas)

☑ Drinking Water ☐ Swimming Pool/Spa

System Number: 27069

System Name: BIG PLAINS SSD

Address: 1777 N. MEADOW LARK DR.

APPLE VALLEY, UT 84737

Phone # 682-8358

Lab Numbers: W17-109-18

Report Drinking Water Sample as:

☐ Routine

☑ Investigative

Is Sample Chlorinated? ☑ Yes ☐ No

☐ Present Coliform Recheck

Original Sample #: ______

Original Sample Date: ______

Instructions to Samplers: Sample must be above the 100 ml mark, on ice and above freezing. Samples taken the previous day must be above freezing to 6°C

Analysis: ☑ Presence/Absence: TC & E. Coli - SM9223B ☐ HPC by SimPlate

☐ Quantitray: TC & E. Coli - SM9223B (test not certified by NELAP)

Preservation: ☑ Ice/refrig ☐ $Na_2S_2O_3$

Container: ☒ Plastic ☒ Grab Sample

Sampler: D. HARRIS Sample Date: 4/19/17 Witnessed by: ______

Released by: D. HARRIS Date: 4/19/17 Time: 1205 Received by: ______ Date: ______ Time: ______

Released by: ______ Date: ______ Time: ______

Received in lab by: [illegible] Date: 4/19/17 Time: 12:55 p

Lab Use Only

Sample Condition

Holding Time ✓ Air Space in bottle ✓

Volume (100ml) ✓ Sample on Ice ✓

Temp of bottle (°C) 6.1

Test Results

	SM9223B	SimPlate
Test Method:	SM9223B	SimPlate
Test Date:	4/19/17	
Test Time:	3:39p	
Bench Sheet #:	58	
Tested By:	[illegible]	

#	Sample Location	Sample Time	Chlorine	Sample Lab Number	Total Coliforms Present	Total Coliforms Absent	E. Coli Present	E. Coli Absent	MPN/ml (MDL = 2)
1	ANGEL MAIN LINE	1000	[illegible]	W17-109-18		✓		✓	
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments

Notified/Messaged client about sample: ☐ Result Violation ☐ Positive Chlorine, Sample rejected ☐ Not Received on Ice ☐ Outside >0-6°C, the day after sampling ☐ Other: ______

Reported to Required Authorities by: ______ Date Sent: ______

The test results for the sample(s) entered on this report meet all the requirements for NELAP unless otherwise noted and relate to the sample(s) as received by the St. George Regional Water Reclamation Laboratory.

Approved by: [signature] Title: Lab Director Date Issued: 4/24/17

Leslie Wernland

Page 1 of 1

Lab Form DW 0112 revised by lr 1/10/12

ST. GEORGE REGIONAL WATER RECLAMATION LABORATORY ANALYSIS REPORT FORM

3780 South 1550 West, St. George, Utah 84790; (435)-627-4279; Fax (435)-634-5846

CUSTOMER INFORMATION: (fill out Bold areas)

[X] Drinking Water [ ] Swimming Pool/Spa

System Number: 27069

System Name: BIG PLAINS SSD

Address: 1777 N. MEADOW LARK DR. APPLE VALLEY, UT 84737

Phone # 632-8358

Lab Numbers: W17-109-16

Report Drinking Water Sample as:

[X] Routine

[ ] Investigative

Is Sample Chlorinated? [X] Yes [ ] No

[ ] Present Coliform Recheck

Original Sample #:

Original Sample Date:

Instructions to Samplers: Sample must be above the 100 ml mark, on ice and above freezing. Samples taken the previous day must be above freezing to 6°C

Analysis: [X] Presence/Absence: TC & E. Coli - SM9223B [ ] HPC by SimPlate [ ] Quantitray: TC & E. Coli - SM9223B (test not certified by NELAP)

Preservation: [X] Ice/refrig [ ] $Na_2S_2O_3$

Container: [X] Plastic [X] Grab Sample

Sampler: D. HARRIS Sample Date: 4/19/17 Witnessed by:

Released by: D. HARRIS Date: 4/19/17 Time: 1230 Received by: Date: Time:

Released by: Date: Time:

Received in lab by: DW Date: 4/19/17 Time: 12:55 A/P DW 4/19/17

Lab Use Only

Sample Condition

Holding Time ✓ Air Space in bottle ✓

Volume (100ml) ✓ Sample on ice ✓

Temp of bottle (°C) 14.9

Test Results

	SM9223B	SimPlate
Test Method:	SM9223B	SimPlate
Test Date:	4/19/17	
Test Time:	3:39p	
Bench Sheet #:	58	
Tested By:	DW	

#	Sample Location	Sample Time	Chlorine	Sample Lab Number	Total Coliforms Present	Total Coliforms Absent	E. Coli Present	E. Coli Absent	MPN/ml (MDL = 2)
1	1878 N. CARTLAND DR.	1030	0.2	W17-109-16		✓		✓	
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments

Notified/Messaged client about sample: [ ] Result Violation [ ] Positive Chlorine, Sample rejected [ ] Not Received on Ice

[ ] Outside >0-6°C, the day after sampling [ ] Other:

Reported to Required Authorities by: DW Date Sent: 4/25/17

The test results for the sample(s) entered on this report meet all the requirements for NELAP unless otherwise noted and relate to the sample(s) as received by the St. George Regional Water Reclamation Laboratory

Approved by: Leslie Wentland Title: Lab Director Date Issued: 4/24/17

Leslie Wentland

Page 1 of 1 Lab Form DW 0112 revised by lf 1/10/12

ST. GEORGE REGIONAL WATER RECLAMATION LABORATORY ANALYSIS REPORT FORM

3780 South 1550 West, St. George, Utah 84790; (435)-627-4279; Fax (435)-634-5846

CUSTOMER INFORMATION: (fill out Bold areas)

☑ Drinking Water ☐ Swimming Pool/Spa

System Number: 27089

System Name: BIG PLAINS SSD

Address: 1777 N. MEADOW CANAL DR. APPLE VALLEY, UT 84737

Phone # 632-8358

Lab Numbers: W17-109-17

Report Drinking Water Sample as:

☑ Routine

☐ Investigative

Is Sample Chlorinated? ☑ Yes ☐ No

☐ Present Coliform Recheck

Original Sample #:

Original Sample Date:

Instructions to Samplers: Sample must be above the 100 ml mark, on ice and above freezing. Samples taken the previous day must be above freezing to 6°C

Analysis: ☑ Presence/Absence: TC & E. Coli - SM9223B ☐ HPC by SimPlate

☐ Quantitray: TC & E. Coli - SM9223B (test not certified by NELAP)

Preservation: ☑ Ice/refrig ☐ $Na_2S_2O_3$

Container: [X] Plastic [X] Grab Sample

Sampler: S-HARRIS Sample Date: 4/19/17 Witnessed by:

Released by: S HARRIS Date: 4/19/17 Time: 1255 Received by: Date: Time:

Released by: Date: Time:

Received in lab by: 26 Date: 4/19/17 Time: 02:55p

Lab Use Only

Sample Condition

Holding Time ✓ Air Space in bottle ✓

Volume (100ml) ✓ Sample on Ice ✓

Temp of bottle (°C) 14.8

Test Results

	SM9223B	SimPlate
Test Method:	SM9223B	SimPlate
Test Date:	4/19/17	
Test Time:	3:39p	
Bench Sheet #:	58	
Tested By:	SW	

#	Sample Location	Sample Time	Chlorine	Sample Lab Number	Total Coliforms Present	Total Coliforms Absent	E. Coli Present	E. Coli Absent	MPN/ml (MDL = 2)
1	ZIONS CAMP	1100	0.1	W17-109-17		✓		✓	
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments

Notified/Messaged client about sample: ☐ Result Violation ☐ Positive Chlorine, Sample rejected ☐ Not Received on Ice ☐ Outside >0-6°C, the day after sampling ☐ Other:

Reported to Required Authorities by: SW Date Sent: 4/25/17

The test results for the sample(s) entered on this report meet all the requirements for NELAP unless otherwise noted and relate to the sample(s) as received by the St. George Regional Water Reclamation Laboratory.

Approved by: Leslie Westland Title: Lab Director Date Issued: 4/24/17

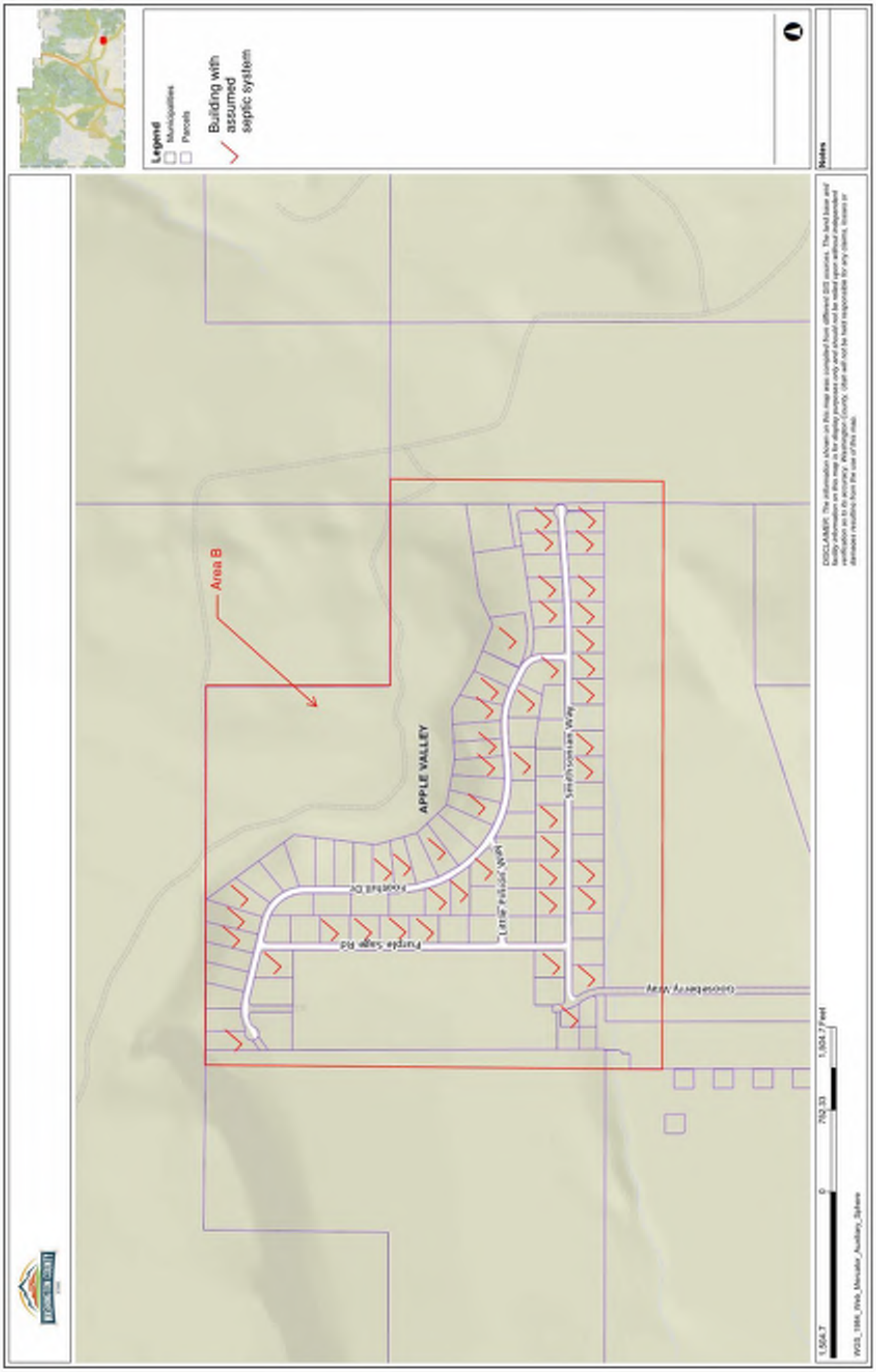
Page 1 of 1

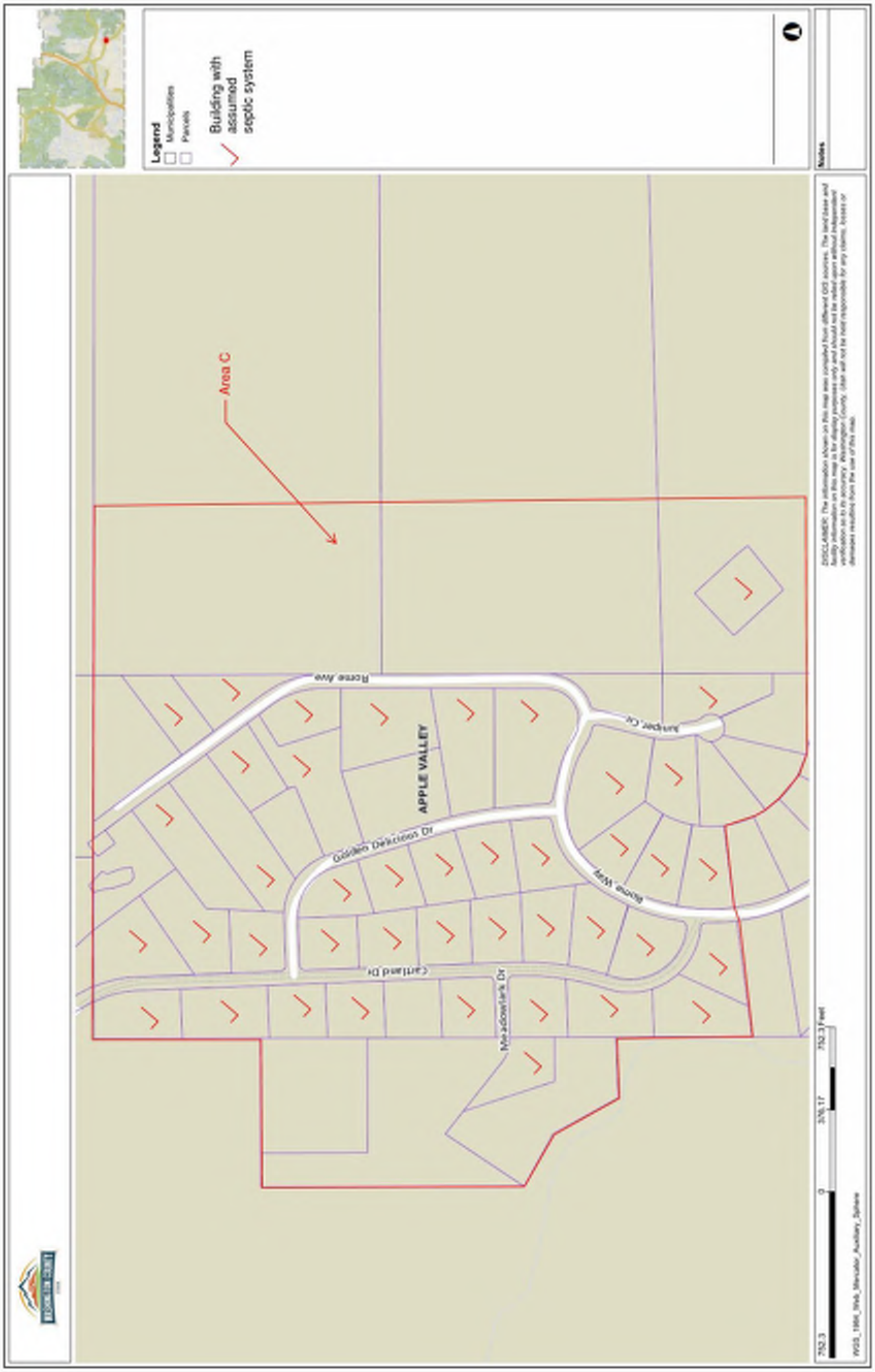
Lab Form DW 0112 revised by lf 1/10/12

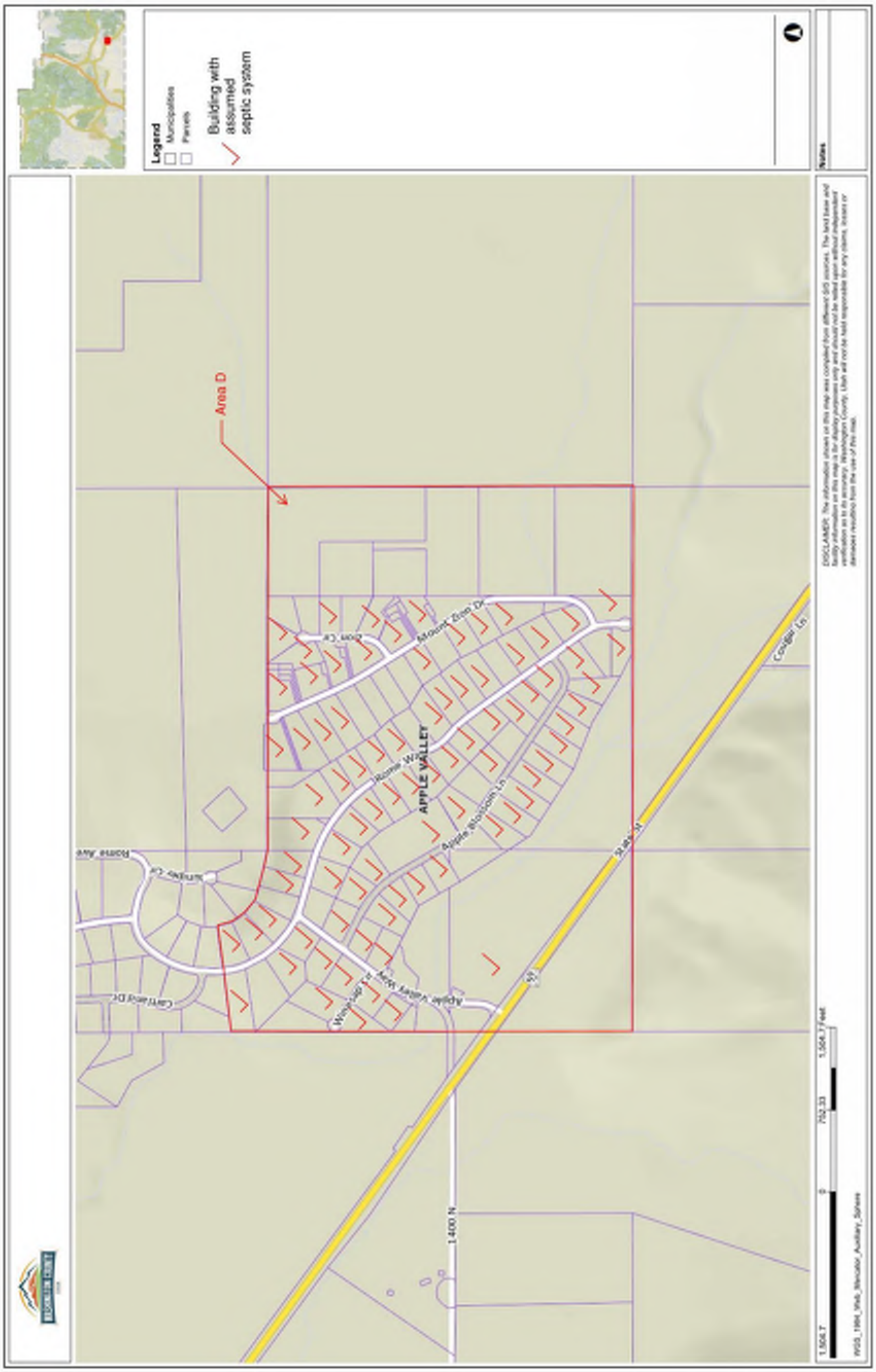
APPENDIX F

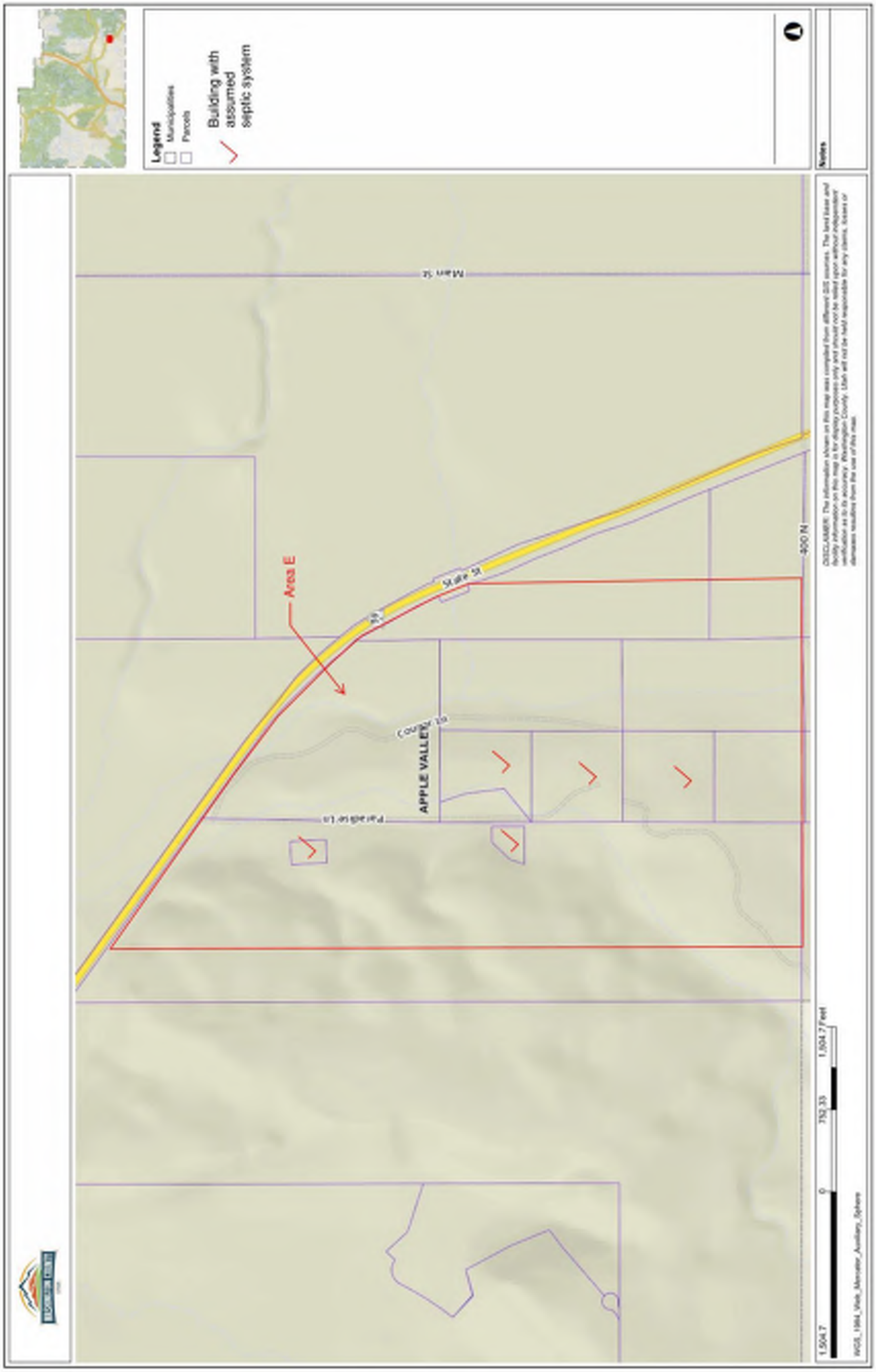
Town Parcels and Areas

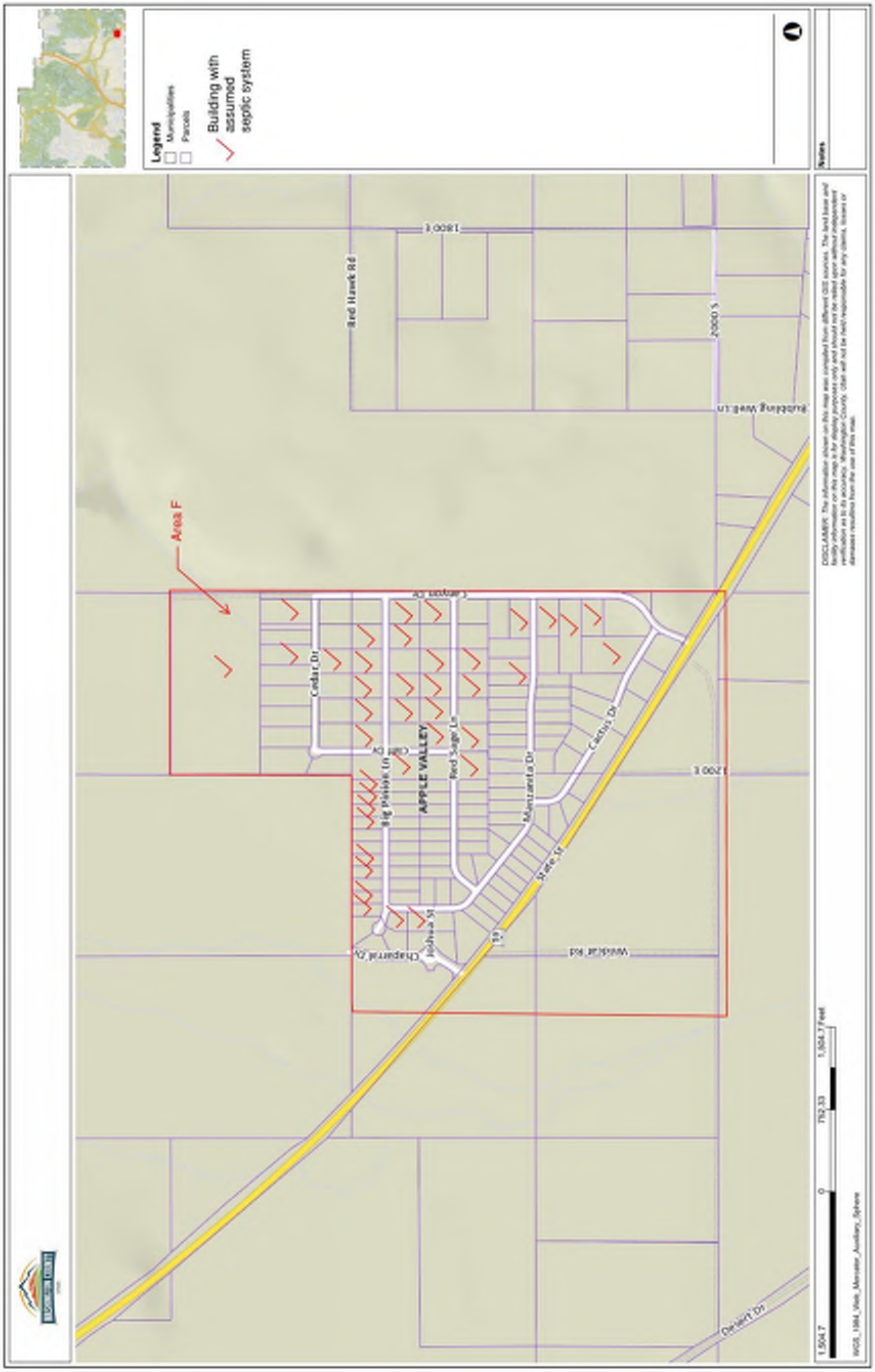

Legend
Municipalities
Parcels
Building with assumed septic system
Area A
APPLE VALLEY
Apple Valley Dr
1400 N
Notes


Legend
Building with assumed septic system
Area B
APPLE VALLEY
Notes


Legend
Municipalities
Parcels
Building with assumed septic system
Notes
Area C
APPLE VALLEY
Rome Ave
Juniper Cir
Golden Delicious Dr
Rome Way
Cortland Dr
Meadowlark Dr
752.3
0
376.17
752.3 Feet

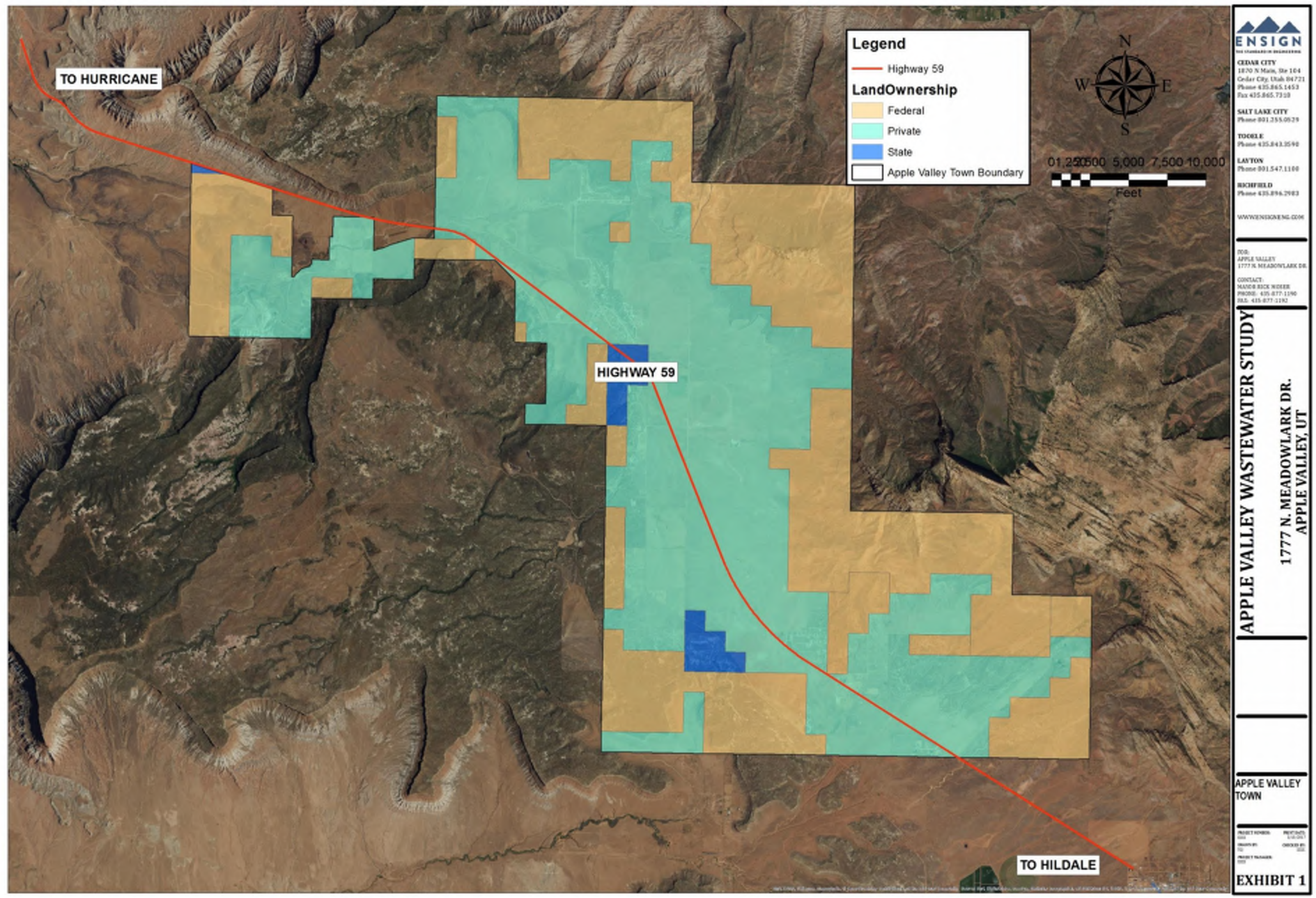

Legend
Municipalities
Parcels
Building with assumed septic system
Area D
APPLE VALLEY
Mount Zion Dr
Rome Way
Apple Blossom Ln
Apple Valley Way
State St
Cougar Ln
1400 N
Notes

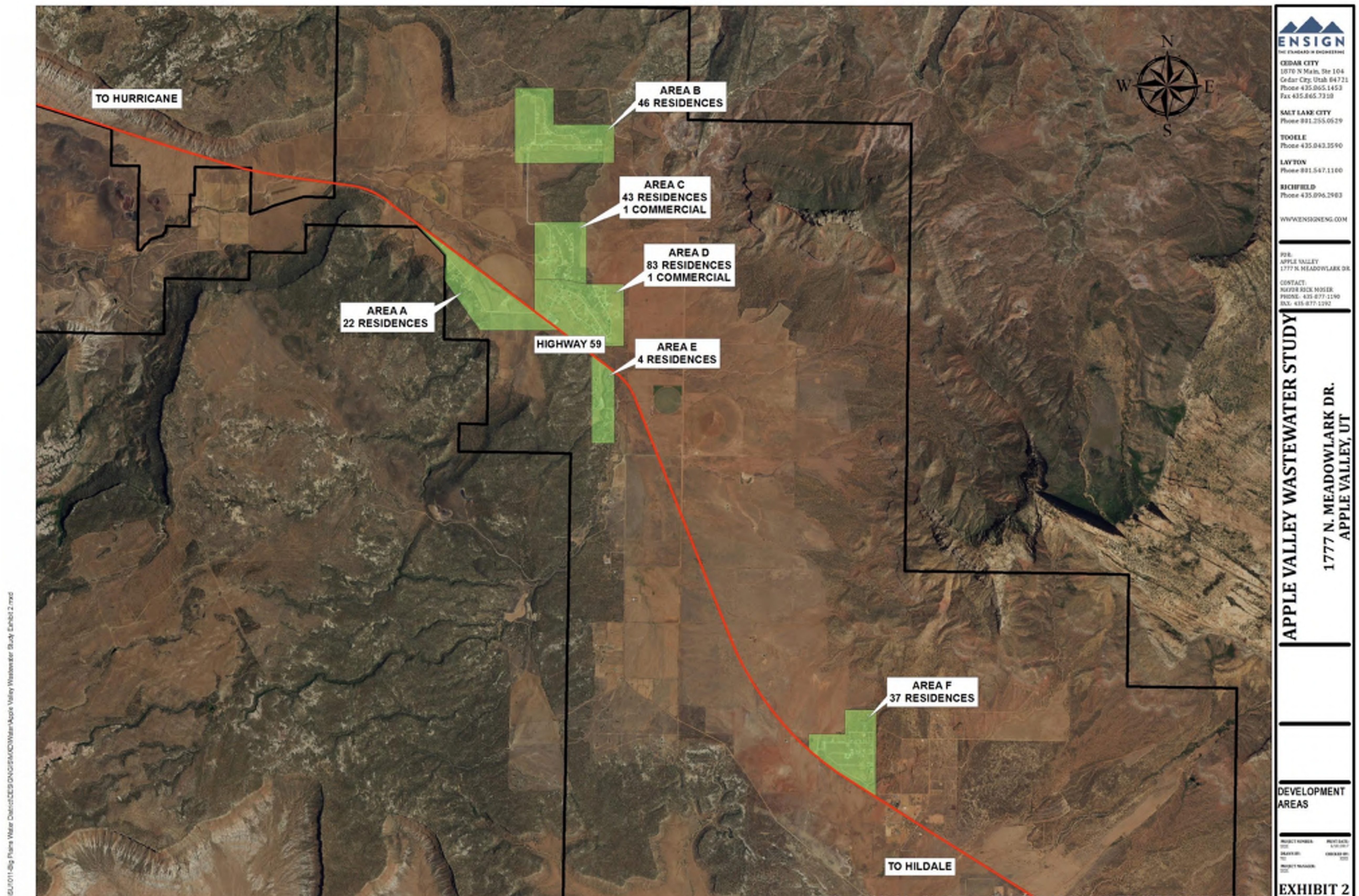

Legend
Municipalities
Parcels
Building with assumed septic system
Notes
Main St
State St
89
Area E
APPLE VALLEY
Paradise Ln
400 N
1,504.7
0
752.33
1,504.7 Feet
WGS_1984_Web_Mercator_Auxiliary_Sphere

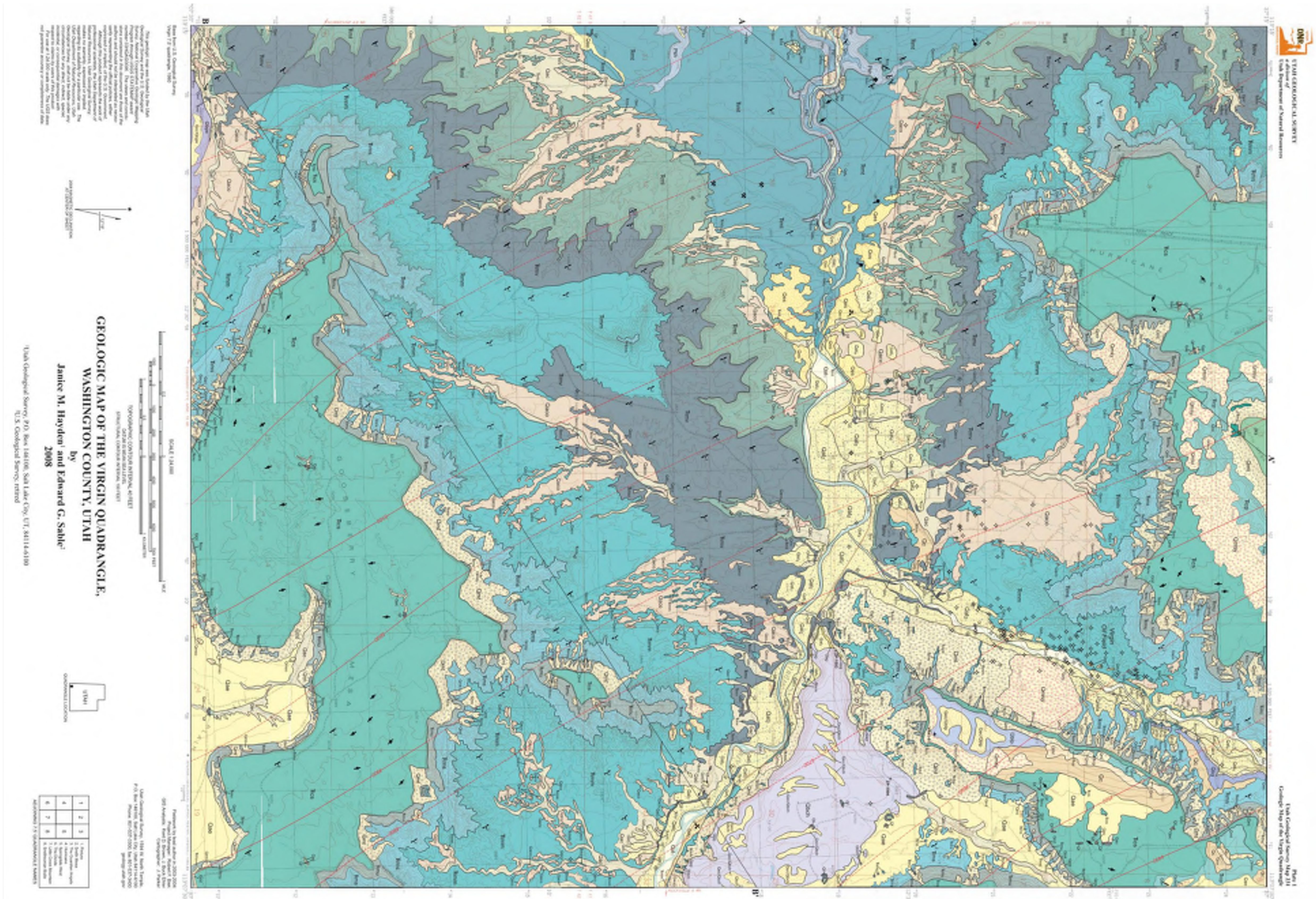

Legend
Municipalities
Parcels
Building with assumed septic system
Notes
Area F
APPLE VALLEY
Cedar Dr
Big Plains Ln
Red Sage Ln
Manzanita Dr
Cactus Dr
State St
Joshua St
Chaparral Dr
Wildcat Rd
Red Hawk Rd
Bubbling Well Ln
Desert Dr
1800 E
1700 E
2000 S
59
1,504.7
0
752.33
1,504.7 Feet

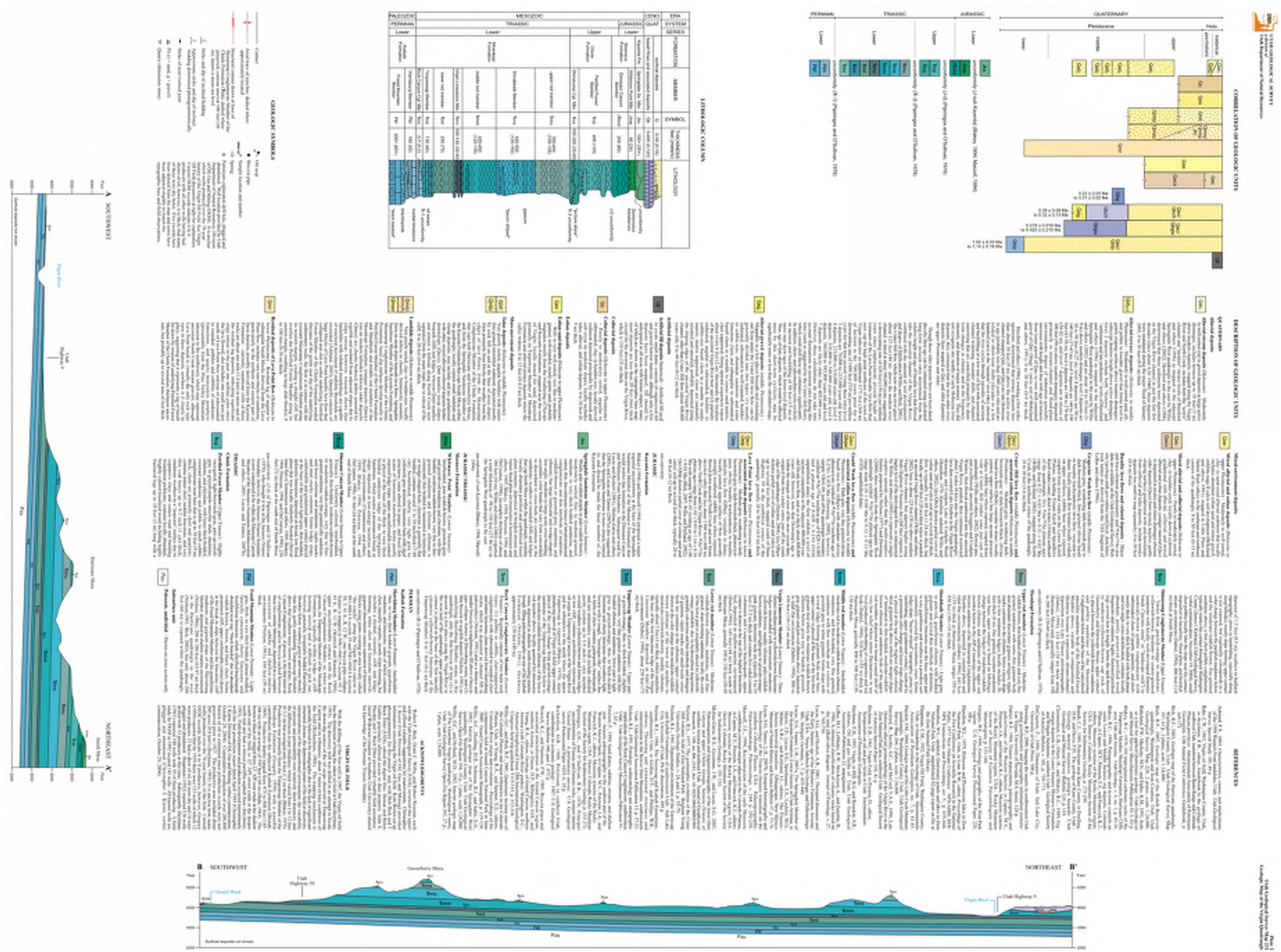
APPENDIX G

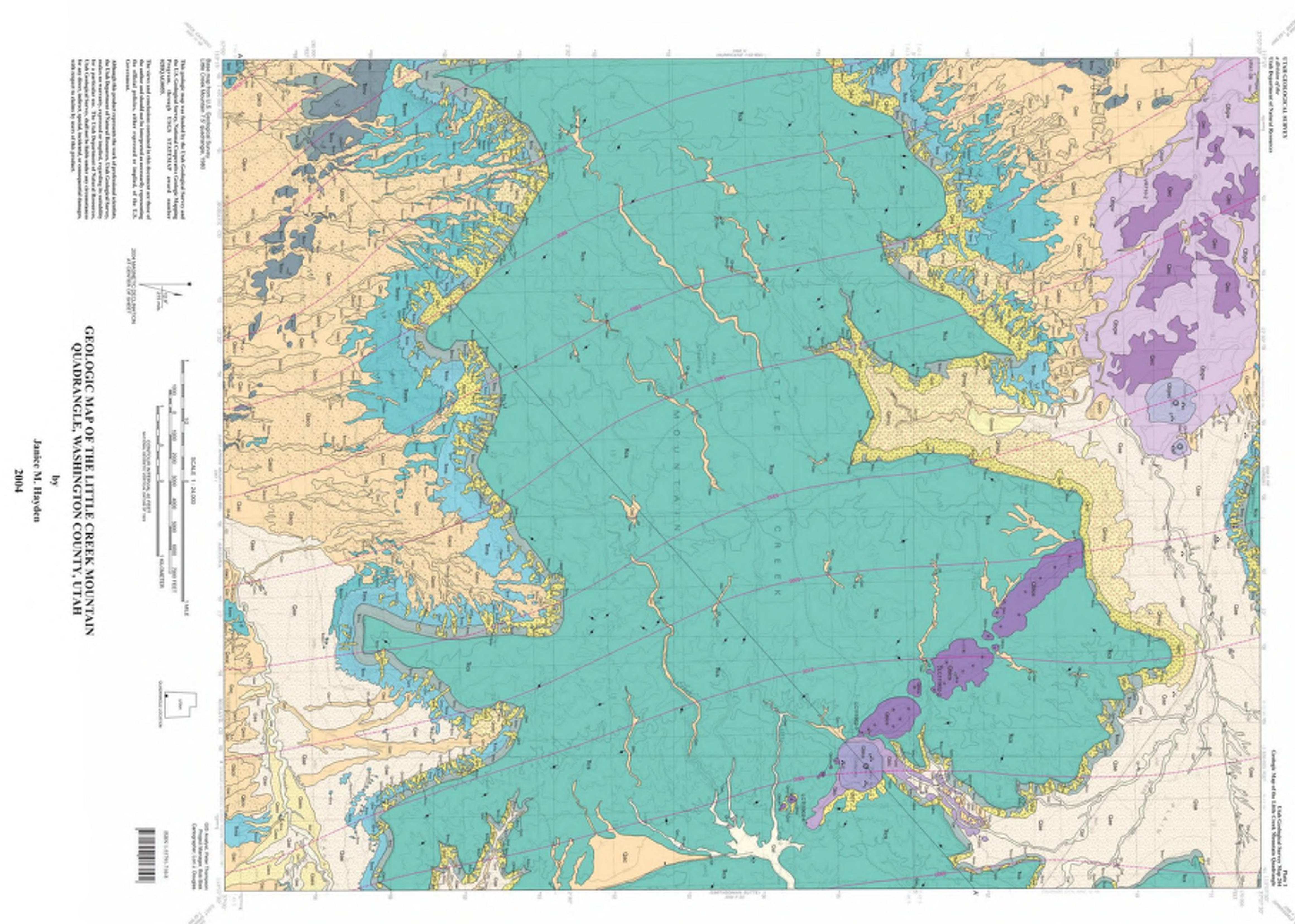
Exhibits and Geological Maps

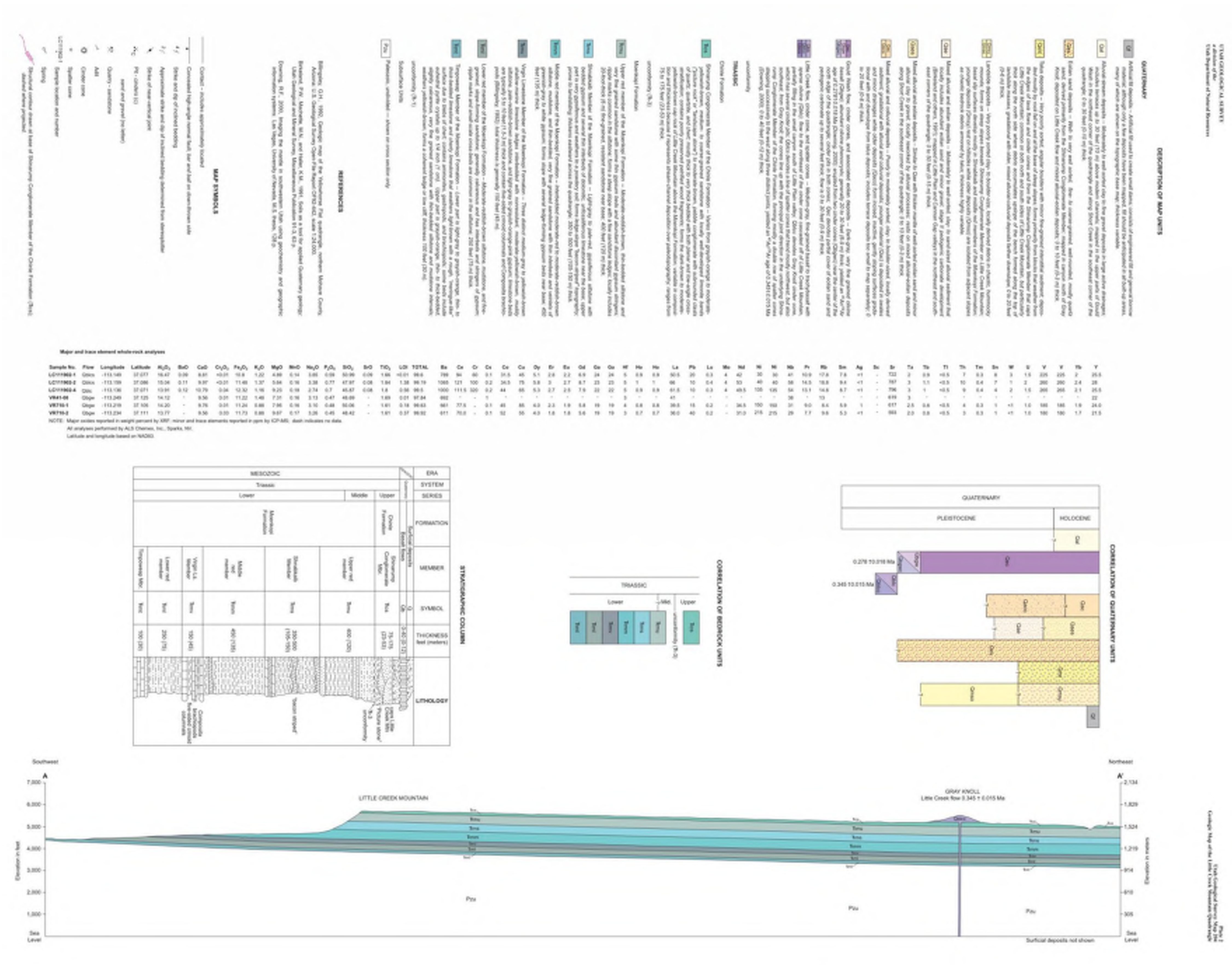

TO HURRICANE
HIGHWAY 59
TO HILDALE
Legend
Highway 59
LandOwnership
Federal
Private
State
Apple Valley Town Boundary
N
W
E
S
Feet
ENSIGN
CEDAR CITY
1870 N Main, Ste 104
Cedar City, Utah 84721
Phone 435.865.1453
Fax 435.865.7310
SALT LAKE CITY
Phone 801.255.0529
TOOELE
Phone 435.843.3590
LAYTON
Phone 801.547.1100
RICHFIELD
Phone 435.896.2983
APPLE VALLEY WASTEWATER STUDY
1777 N. MEADOWLARK DR.
APPLE VALLEY, UT
APPLE VALLEY TOWN
EXHIBIT 1

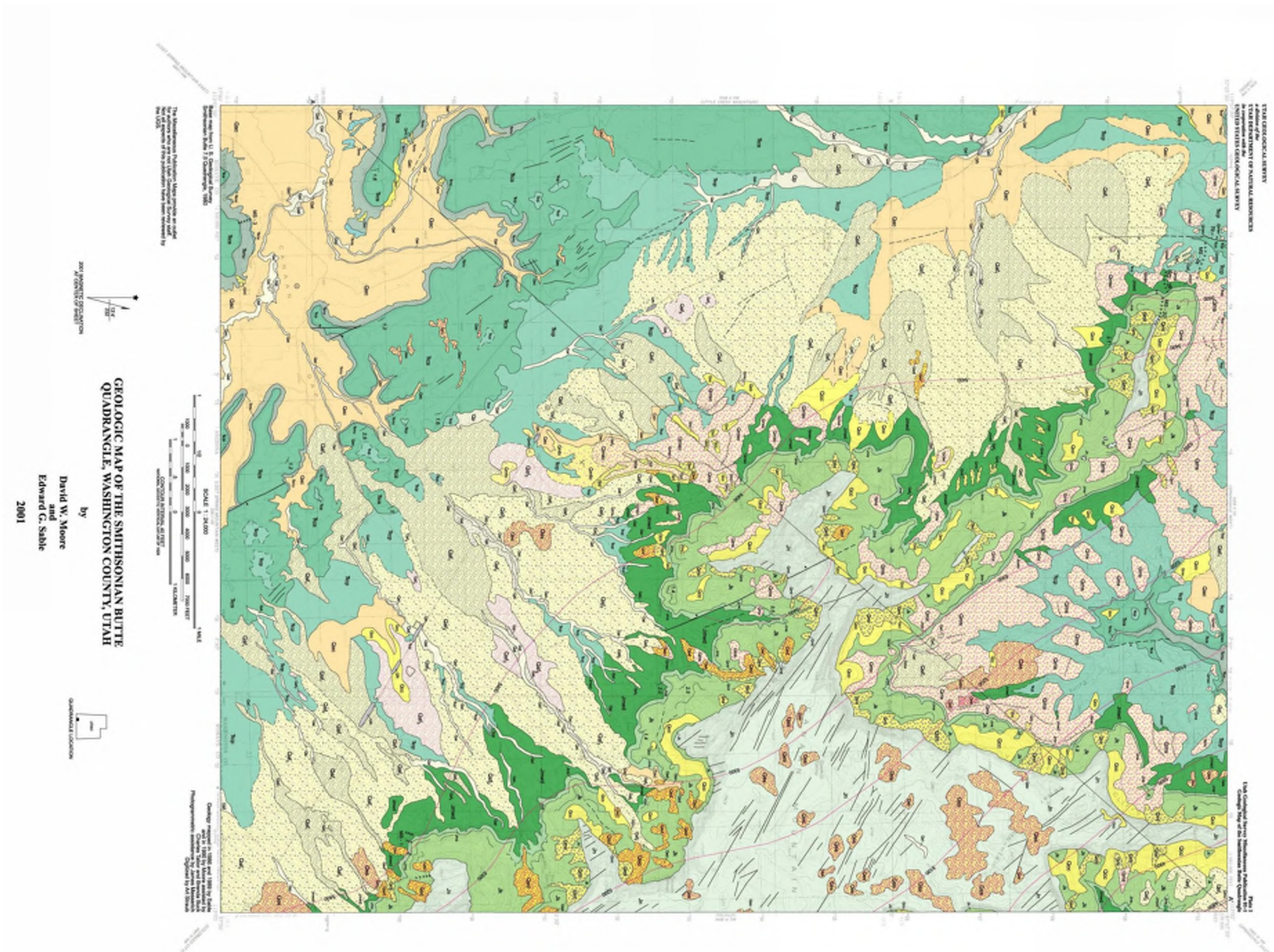

TO HURRICANE
AREA B
46 RESIDENCES
AREA C
43 RESIDENCES
1 COMMERCIAL
AREA D
83 RESIDENCES
1 COMMERCIAL
AREA A
22 RESIDENCES
HIGHWAY 59
AREA E
4 RESIDENCES
AREA F
37 RESIDENCES
TO HILDALE
N
S
W
E
ENSIGN
CEDAR CITY
SALT LAKE CITY
TOOELE
LAYTON
RICHFIELD
APPLE VALLEY WASTEWATER STUDY
1777 N. MEADOWLARK DR.
APPLE VALLEY, UT
DEVELOPMENT AREAS
EXHIBIT 2

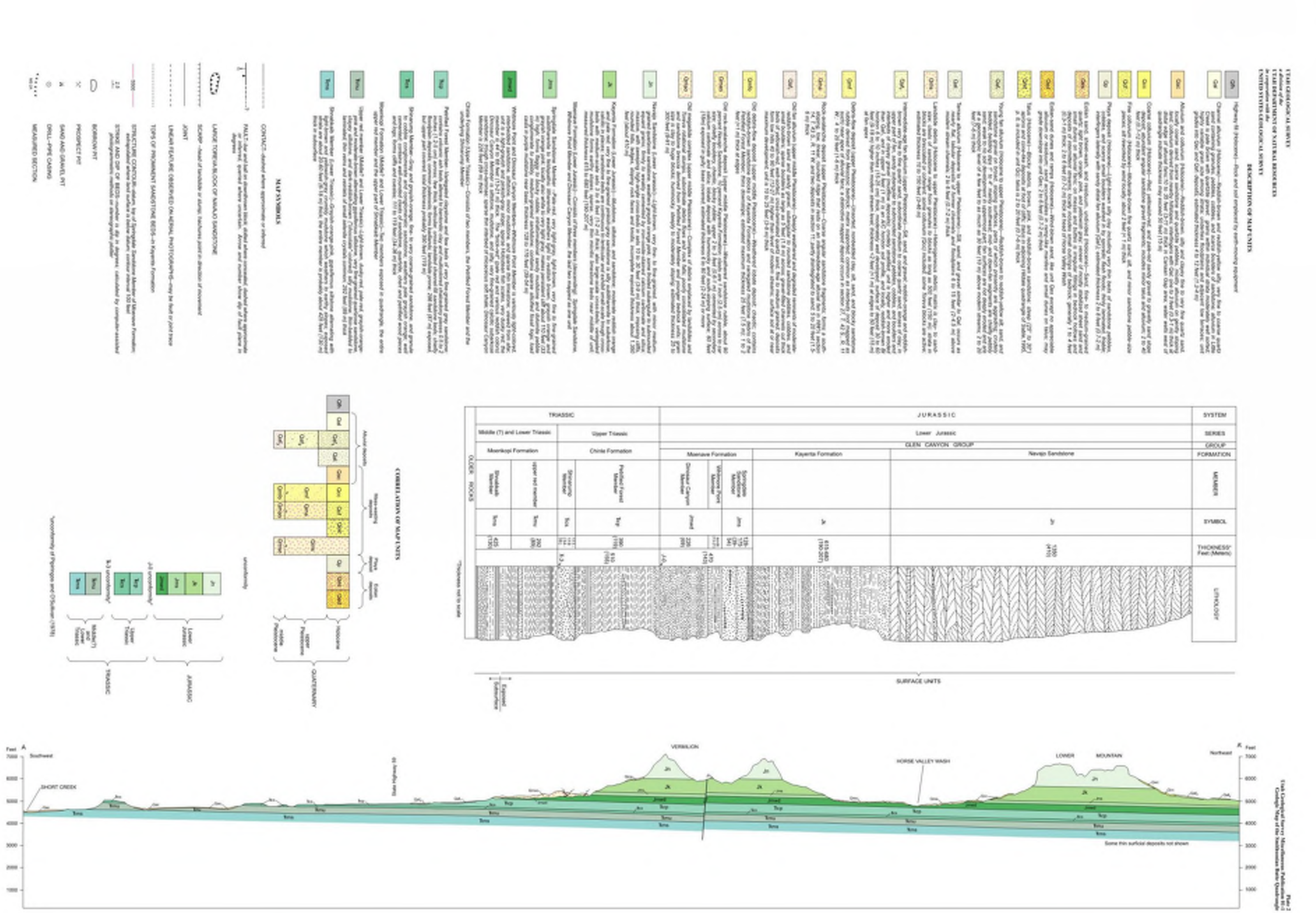

GEOLOGIC MAP OF THE VIRGIN QUADRANGLE,
WASHINGTON COUNTY, UTAH
by
Janice M. Hayden and Edward G. Sable
2008
UTAH GEOLOGICAL SURVEY

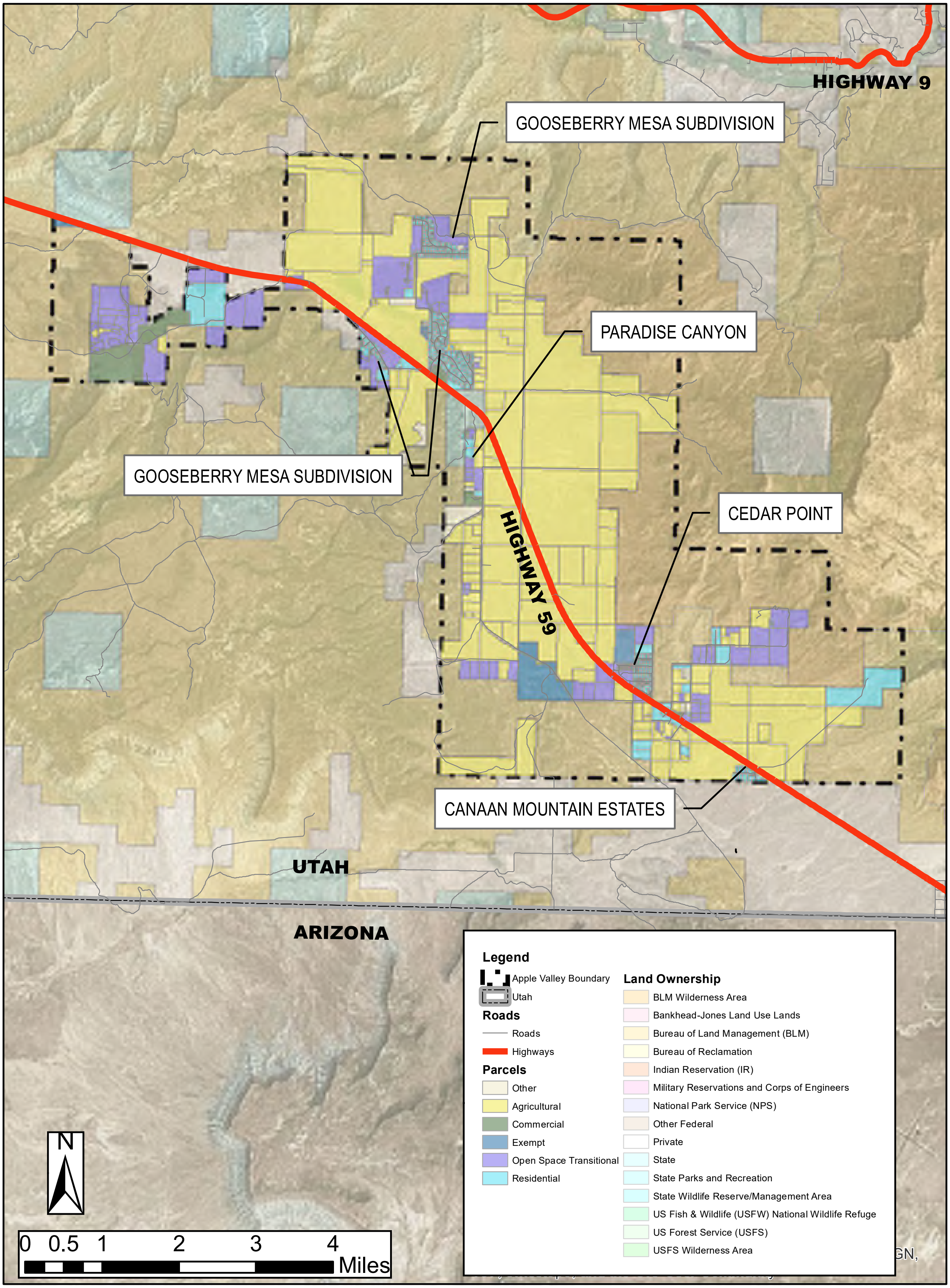


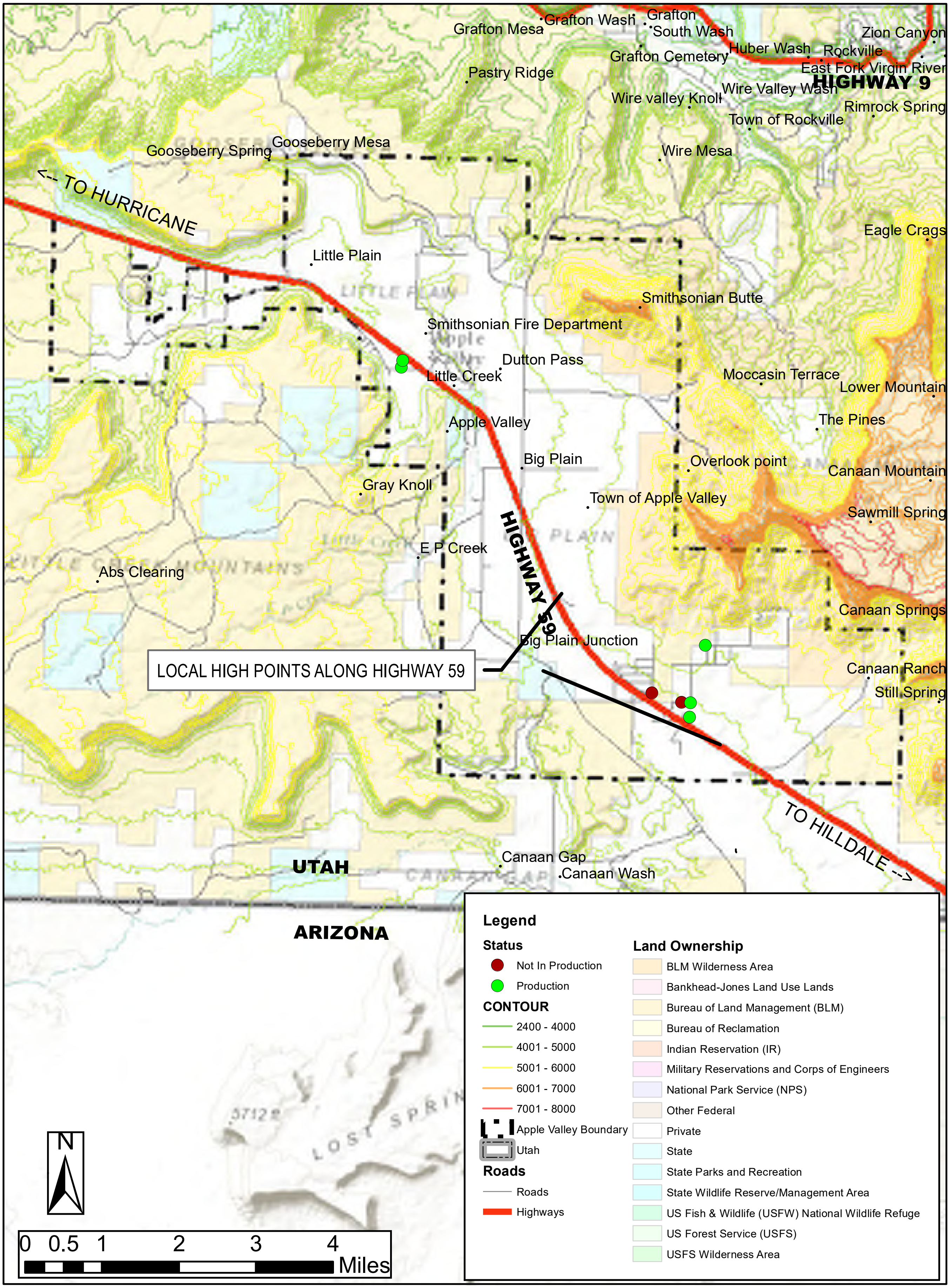

GEOLOGIC MAP OF THE LITTLE CREEK MOUNTAIN
QUADRANGLE, WASHINGTON COUNTY, UTAH
by
Janice M. Hayden
2004
LITTLE CREEK MOUNTAIN

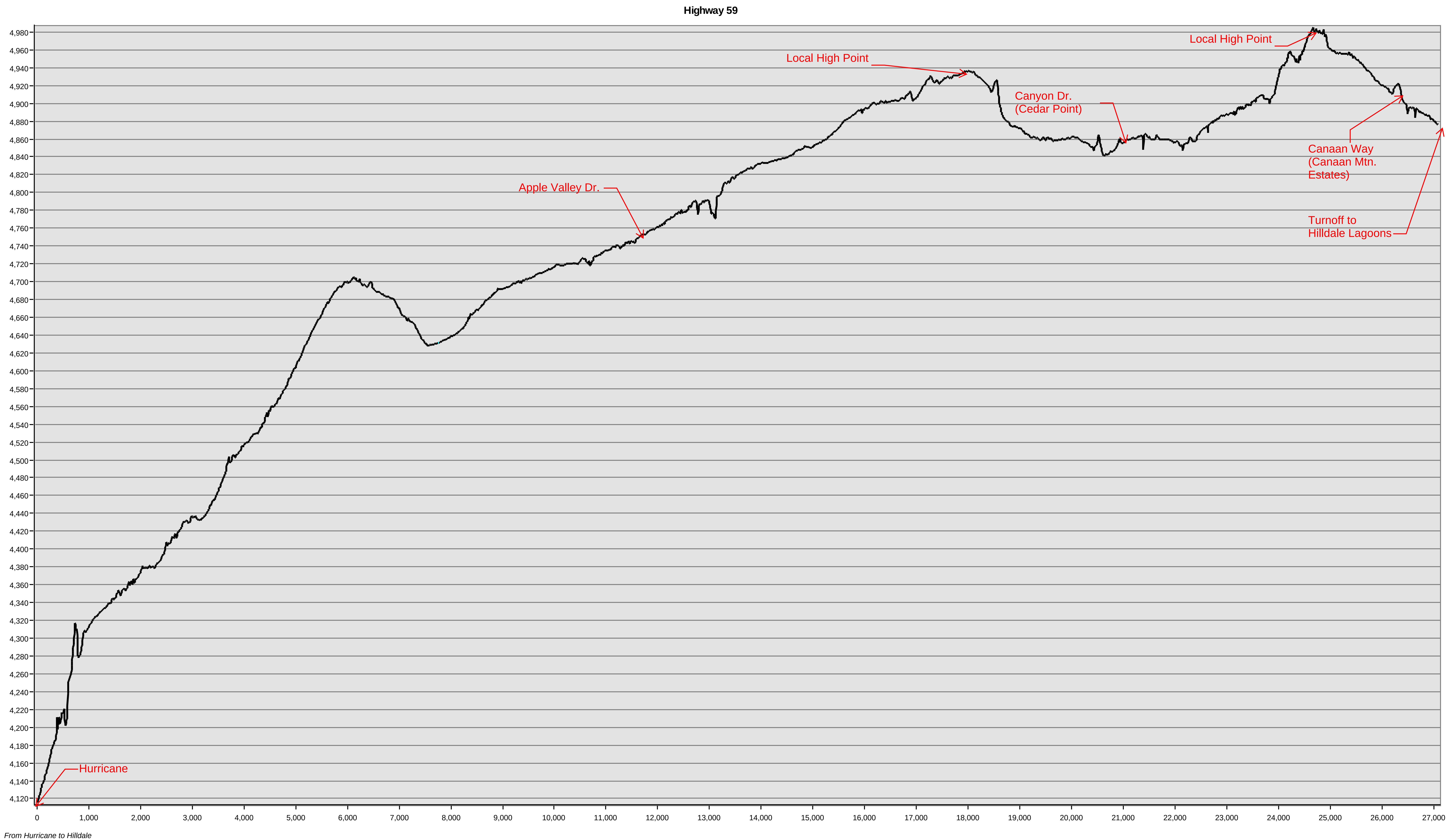

LITTLE CREEK MOUNTAIN
GRAY KNOLL
Southwest
Northeast


GEOLOGIC MAP OF THE SMITHSONIAN BUTTE
QUADRANGLE, WASHINGTON COUNTY, UTAH
by
David W. Moore
and
Edward G. Sable
2001


SURFACE UNITS
Southwest
SHORT CREEK
VERMILION
HORSE VALLEY WASH
LOWER
MOUNTAIN
Northeast
Some thin surficial deposits not shown


HIGHWAY 9
GOOSEBERRY MESA SUBDIVISION
PARADISE CANYON
GOOSEBERRY MESA SUBDIVISION
HIGHWAY 59
CEDAR POINT
CANAAN MOUNTAIN ESTATES
UTAH
ARIZONA
Legend
Apple Valley Boundary
Utah
Roads
Roads
Highways
Parcels
Other
Agricultural
Commercial
Exempt
Open Space Transitional
Residential
Land Ownership
BLM Wilderness Area
Bankhead-Jones Land Use Lands
Bureau of Land Management (BLM)
Bureau of Reclamation
Indian Reservation (IR)
Military Reservations and Corps of Engineers
National Park Service (NPS)
Other Federal
Private
State
State Parks and Recreation
State Wildlife Reserve/Management Area
US Fish & Wildlife (USFW) National Wildlife Refuge
US Forest Service (USFS)
USFS Wilderness Area
N
0 0.5 1 2 3 4
Miles


Grafton Mesa
Grafton Wash
Grafton
South Wash
Zion Canyon
Grafton Cemetery
Huber Wash
Rockville
East Fork Virgin River
HIGHWAY 9
Pastry Ridge
Wire valley Knoll
Wire Valley Wash
Rimrock Spring
Town of Rockville
Gooseberry Spring
Gooseberry Mesa
Wire Mesa
<-- TO HURRICANE
Eagle Crags
Little Plain
Smithsonian Butte
Smithsonian Fire Department
Dutton Pass
Little Creek
Moccasin Terrace
Lower Mountain
Apple Valley
The Pines
Big Plain
Overlook point
Canaan Mountain
Gray Knoll
Town of Apple Valley
Sawmill Spring
HIGHWAY 59
E P Creek
Abs Clearing
Canaan Springs
Big Plain Junction
LOCAL HIGH POINTS ALONG HIGHWAY 59
Canaan Ranch
Still Spring
TO HILLDALE -->
Canaan Gap
Canaan Wash
UTAH
ARIZONA
N
0 0.5 1 2 3 4
Miles
Legend
Status
Not In Production
Production
CONTOUR
2400 - 4000
4001 - 5000
5001 - 6000
6001 - 7000
7001 - 8000
Apple Valley Boundary
Utah
Roads
Roads
Highways
Land Ownership
BLM Wilderness Area
Bankhead-Jones Land Use Lands
Bureau of Land Management (BLM)
Bureau of Reclamation
Indian Reservation (IR)
Military Reservations and Corps of Engineers
National Park Service (NPS)
Other Federal
Private
State
State Parks and Recreation
State Wildlife Reserve/Management Area
US Fish & Wildlife (USFW) National Wildlife Refuge
US Forest Service (USFS)
USFS Wilderness Area


Highway 59
Local High Point
Local High Point
Canyon Dr.
(Cedar Point)
Apple Valley Dr.
Canaan Way
(Canaan Mtn.
Estates)
Turnoff to
Hilldale Lagoons
Hurricane
4,980
4,960
4,940
4,920
4,900
4,880
4,860
4,840
4,820
4,800
4,780
4,760
4,740
4,720
4,700
4,680
4,660
4,640
4,620
4,600
4,580
4,560
4,540
4,520
4,500
4,480
4,460
4,440
4,420
4,400
4,380
4,360
4,340
4,320
4,300
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4,220
4,200
4,180
4,160
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4,120
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26,000
27,000
From Hurricane to Hilldale

P:\SU1011E\GIS\Apple Valley 2D.MXD

RICHFIELD
5 West Constitution Way
Ste 1140
Richfield, UT. 84071
Phone: 435.896.2983

SALT LAKE
Phone 801.255.0529

TOOELE
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LAYTON
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CEDAR CITY
Phone 435.865.1453

WWW.ENSIGNENG.COM

FOR:
BPWSSSD
1777 NORTH MEADOWLARK DRIVE
APPLE VALLEY, UT 84737
CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

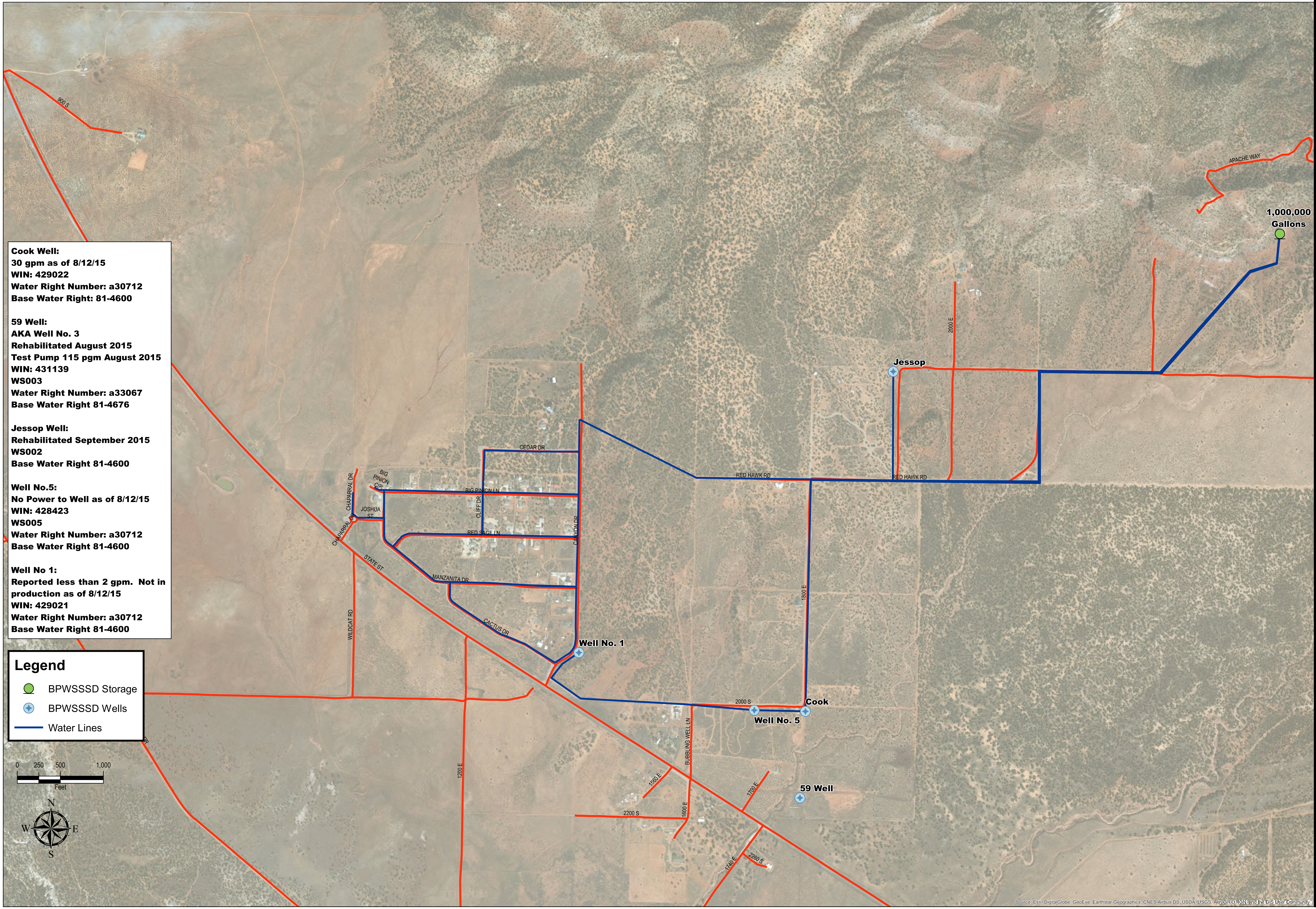
APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
3			
4			
5			
6			
7			
8			

APPLE VALLEY WATER SYSTEM

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-001



P:\SU1011E\GIS\Apple Valley 2D.MXD

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APPLE VALLEY, UT 84737
CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
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6			
7			
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CEDAR POINT WATER SYSTEM

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-002

ENSIGN
THE STANDARD IN ENGINEERING

CEDAR CITY
1870 North Main Street
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Phone 435.843.3590
LAYTON
Phone 801.547.1100
RICHFIELD
Phone 435.896.2983

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FOR:
BPWSSSD
1777 NORTH MEADOWLARK DRIVE
APPLE VALLEY, UT 84737
CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
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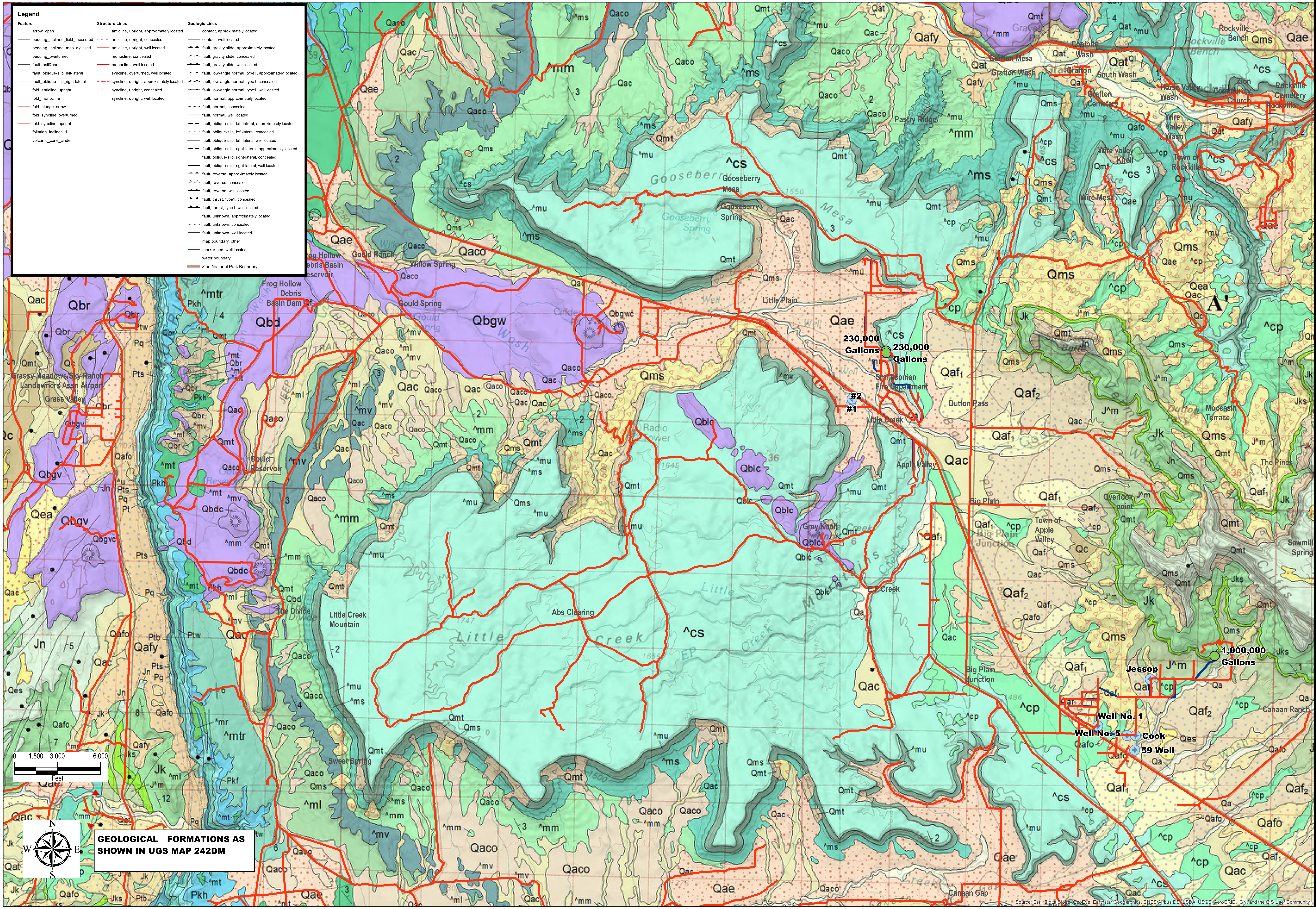
WELL LOCATIONS

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-003



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ENSIGN
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MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
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GEOLOGICAL MAP

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-004

ENSIGN
THE STANDARD IN ENGINEERING

CEDAR CITY
1870 North Main Street
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FOR:
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APPLE VALLEY, UT 84737
CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
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8			

POTENTIOMETRIC SURFACE

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-005

ENSIGN
THE STANDARD IN ENGINEERING

CEDAR CITY
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TOOELE
Phone 435.843.3590

LAYTON
Phone 801.547.1100

RICHFIELD
Phone 435.896.2983

WWW.ENSIGNENG.COM

FOR:
BPWSSSD
1777 NORTH MEADOWLARK DR.
APPLE VALLEY, UT 84737

CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
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POTENTIOMETRIC SURFACE

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-006

ENSIGN
THE STANDARD IN ENGINEERING

RICHFIELD
5 West Constitution Way
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Richfield, UT. 84071
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TOOELE
Phone 435.843.3590

LAYTON
Phone 801.547.1100

CEDAR CITY
Phone 435.865.1453

WWW.ENSIGNENG.COM

FOR:
BPWSSSD
1777 NORTH MEADOWLARK DRIVE
APPLE VALLEY, UT 84737
CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
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5			
6			
7			
8			

REGIONAL TREATMENT ASHCREEK

PROJECT NUMBER: SU1011E
PRINT DATE: 3/28/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-100

ENSIGN
THE STANDARD IN ENGINEERING

RICHFIELD
5 West Constitution Way
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Richfield, UT. 84071
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Phone 801.255.0529

TOOELE
Phone 435.843.3590

LAYTON
Phone 801.547.1100

CEDAR CITY
Phone 435.865.1453

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FOR:
BPWSSSD
1777 NORTH MEADOWLARK DRIVE
APPLE VALLEY, UT 84737
CONTACT:
MAYOR RICHARD MOSER
PHONE: 435-877-1190

BIG PLAINS WASTEWATER EVALUATION

APPLE VALLEY, UTAH

NO.	DATE	REVISION	BY
1			
2			
3			
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6			
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8			

NORTHERN LAGOONS

PROJECT NUMBER: SU1011E
PRINT DATE: 3/29/2018
DRAWN BY: K. CHAPPELL
CHECKED BY: K. CRANE
PROJECT MANAGER: K. CRANE

EX-101

PROJECT TITLE:	PROJECT NUMBER:
BPWSSSD Wastewater Study	SU1178
LOCATION: Apple Valley Utah Utah	DATE: March 29, 2018
OWNER: Virgin Town	APPROVED BY: R. Mills
ESTIMATED BY: K. Chappell	CHECKED BY: C. Nielson

ENSIGN

FACULTATIVE LAGOONS

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. SITE WORK					
001	Land Acquistion	ACRE	25	$ 10,000.00	$ 250,000.00
003	Stock-Tight Fence	L.F.	1,500	$ 6.00	$ 9,000.00
004	RipRap	C.Y.	2,150	$ 20.00	$ 43,000.00
005	6" Dia. PVC Force Main	L.F.	300	$ 21.00	$ 6,300.00
006	10" Dia. HDPE Pipe	L.F.	300	$ 35.00	$ 10,500.00
007	Transfer Structure Valve	E.A.	2	$ 14,000.00	$ 28,000.00
008	Concrete Outlet Structure	E.A.	1	$ 5,000.00	$ 5,000.00
009	Inlet Pad	E.A.	2	$ 2,500.00	$ 5,000.00
010	Lagoon Site Preparation	L.S.	1	$ 40,000.00	$ 40,000.00
012	Compacted Embankment	C.Y.	50,000	$ 4.00	$ 200,000.00
013	Uncompacted Embankment	C.Y.	5,000	$ 4.00	$ 20,000.00
014	6' Chain Link Fence with Barbed Wire	L.F.	3,500	$ 21.00	$ 73,500.00
015	16' Double Panel Chain Link Gate	E.A.	1	$ 750.00	$ 750.00
016	3' Chain Link Gate	E.A.	1	$ 300.00	$ 300.00
017	Water Level Indicators	E.A.	2	$ 2,000.00	$ 4,000.00
018	Untreated Base Course	C.Y.	500	$ 42.00	$ 21,000.00
019	Access Road	L.F.	1,000	$ 25.00	$ 25,000.00
020	Lift Station	E.A.	1	$ 50,000.00	$ 50,000.00
021	Grinder and Structure	E.A.	1	$ 45,000.00	$ 45,000.00
022	Construction Contingency (15%)	L.S.	1	$ 125,452.50	$ 125,452.50
				Sub Total	**$ 961,802.50**
				Legal & Admin (2%)	$ 167,270.00
				Engineering (18%)	$ 150,543.00
				Total	**$ 1,279,615.50**

REGIONAL TREATMENT BY ASH CREEK SSD					
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. SITE WORK					
002	15" Dia Gravity Interceptor Line	L.F.	61,500	$ 45.00	$ 2,767,500.00
003	Lift/Booster Stations	E.A.	1	$ 65,000.00	$ 65,000.00
004	Backup Generator	E.A.	1	$ 30,000.00	$ 30,000.00
005	5' Dia Manhonles	E.A.	50	$ 2,900.00	$ 145,000.00
006	Highway Crossing 16" Dia.	L.F.	80	$ 300.00	$ 24,000.00
007	Electrical Service	E.A.	1	$ 20,000.00	$ 20,000.00
008	Impact Fee	E.A.	350	$ 2,976.00	$ 1,041,600.00
009	Construction Contingency (15%)	L.S.	1	$ 613,965.00	$ 613,965.00
				Sub Total	**$ 4,707,065.00**
				Legal & Admin (2%)	$ 81,862.00
				Engineering (18%)	$ 736,758.00
				Total	**$ 5,525,685.00**

Apple Valley to North Sewer Lagoons					
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. SITE WORK					
002	Manhole, 4' Dia.	E.A.	105	$ 2,900.00	$ 304,500.00
003	12" Dia. PVC Pipe	L.F.	4,200	$ 30.00	$ 126,000.00
009	Highway Crossing, 16" Dia. Casing	L.F.	80	$ 300.00	$ 24,000.00
010	Class "C" Roadway Repair	S.Y.	1,000	$ 16.00	$ 16,000.00
016	Construction Contingency (15%)	L.S.	1	$ 70,575.00	$ 70,575.00
				Sub Total	**$ 541,075.00**
				Legal & Admin (2%)	$ 9,410.00
				Engineering (18%)	$ 84,690.00
				Total	**$ 635,175.00**

Cedar Point to South Sewer Lagoons					
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. SITE WORK					
002	Manhole, 4' Dia.	E.A.	105	$ 2,900.00	$ 304,500.00
003	12" Dia. PVC Pipe	L.F.	1,500	$ 35.00	$ 52,500.00
009	Highway Crossing, 16" Dia. Casing	L.F.	80	$ 300.00	$ 24,000.00
010	Class "A" Roadway Repair	S.Y.	1,000	$ 36.00	$ 36,000.00
016	Construction Contingency (15%)	L.S.	1	$ 62,550.00	$ 62,550.00
				Sub Total	**$ 479,550.00**
				Legal & Admin (2%)	$ 8,340.00
				Engineering (18%)	$ 75,060.00
				Total	**$ 562,950.00**

Gooseberry Gravity Collection					
ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL

1. SITE WORK					
002	Manhole, 4' Dia.	E.A.	65	$ 2,900.00	$ 188,785.86
003	8" Dia. PVC SDR-35 Pipe	L.F.	8,974	$ 24.00	$ 215,376.00
004	12" Dia. PVC SDR-35 Pipe	L.F.	7,080	$ 38.00	$ 269,040.00
005	Service Connection	E.A.	59	$ 2,000.00	$ 118,000.00
006	Construction Contingency (15%)	L.S.	1	$ 118,680.28	$ 118,680.28
				Sub Total	**$ 909,882.14**
				Legal & Admin (2%)	$ 15,824.04
				Engineering (18%)	$ 142,416.33
				Total	**$ 1,068,122.51**

Apple Valley Collection

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
1. SITE WORK					
002	Manhole, 4' Dia.	E.A.	96	$ 2,900.00	$ 277,950.50
003	8" Dia. PVC SDR-35 Pipe	L.F.	19,169	$ 32.00	$ 613,408.00
004	Service Connection	E.A.	141	$ 2,000.00	$ 282,000.00
005	Construction Contingency (15%)	L.S.	1	$ 176,003.78	$ 176,003.78
				Sub Total	**$ 1,349,362.28**
				Legal & Admin (2%)	$ 23,467.17
				Engineering (18%)	$ 211,204.53
				Total	**$ 1,584,033.98**